# THE SCIENCE AND ART

OF

# SURGERY.

"*They be the best* Chirurgeons *which being learned incline to the traditions of experience, or being empirics incline to the methods of learning.*"

**Bacon** *on Learning.*

THE

# SCIENCE AND ART

OF

# SURGERY

BEING

Treatise on Surgical Injuries, Diseases, and Operations.

BY

**~~JOHN ERIC~~ ERICHSEN, F.R.S., F.R.C.S.**

SURGEON EXTRAORDINARY TO HER MAJESTY THE QUEEN.
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CONSULTING SURGEON TO UNIVERSITY COLLEGE HOSPITAL, AND TO VARIOUS MEDICAL CHARITIES.

SEVENTH EDITION,

ENLARGED AND CAREFULLY REVISED.

Illustrated by Eight Hundred and Sixty-two Engravings on Wood.

## VOL. II.

LONDON:
LONGMANS, GREEN, AND CO.
1877.

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LONDON:
BRADBURY, AGNEW, & CO., PRINTERS, WHITEFRIARS.

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one operating directly on the coats of the artery itself, the other influencing them indirectly by inducing changes in the contained blood. To the first belong traumatic causes of all kinds, as the bruising, laceration, division, or ligature of the vessel, and others that more slowly influence it, as the implication and consolidation of its coats in and by the growth and pressure of neighbouring tumours. To the second set of causes, those that act on the coats through the medium of the contained blood, belong blood-changes induced by gout, rheumatism, syphilis, &c.

In the simplest form, arising for instance from the pressure of a tumour upon an artery, the *coats* become thickened, and are fused together, as it were, so as to form an impervious cord ; in the more acute forms of the disease, the sheath and more especially the external coat become pulpy and vascular, with effusion of exudation-matter in and around them. The middle coat does not seem to undergo any primary change, but after a time becomes contracted, thickened, and somewhat softened. The internal coat becomes softened, pulpy, and stained by imbibition of the colouring matter of the blood. In consequence of these changes in the coats, the vessel loses its elasticity, and becomes softened and brittle. After the inflammation has existed a short time, a *plug* or *thrombus* is deposited in the diseased part of the artery. This plug assumes two distinct forms. It may be deposited as a membranous layer of decolorised fibrine, usually thin, but sometimes accumulated in masses, occluding the orifices of collateral branches (Fig. 343); but most frequently it is deposited in the form of a conical plug, which completely blocks up the vessel at the part inflamed, below which the calibre of the artery is somewhat contracted (Fig. 344). The plug or thrombus is formed of two distinct materials. The middle and lower parts consist of a mass of a yellowish or reddish colour, composed of inflammatory exudation-matter, intermingled with fibrine deposited upon it by the circulating blood, and adhering firmly to the contiguous walls of the vessel. The upper portion of the plug is black, and consists of simple coagulum, deposited upon and tailing on to the decolorised mass ; it is usually long, narrow, and stringy, and is not adherent to the sides of the vessels. The plug may continue permanently to block up the artery, which gradually contracts upon it so as to be eventually converted into a fibro-cellular cord ; or it may be partly absorbed or channelled through the centre ; or lastly, it may be entirely removed by absorption, the calibre of the vessel being freely restored. These plugs may continue attached to the

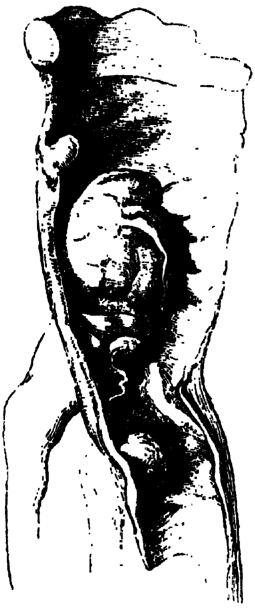


Fig. 343.—Thrombosis of Aorta.

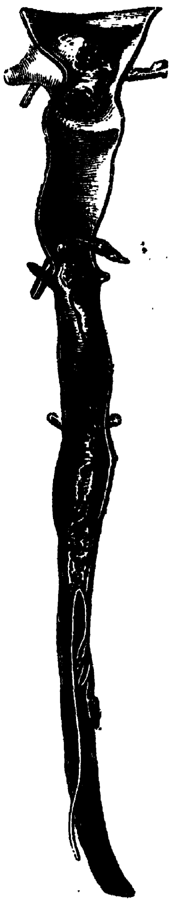


Fig. 344. — Thrombosis of the Axillary Artery, occasioning Gangrene of Hand and Arm.

part of the artery in which they have originally formed; or they may be primarily deposited in one of the larger arteries, the aorta, or even the left cavities of the heart, and thence be washed by the current of the blood into one of the secondary arteries, becoming arrested at some point of bifurcation or narrowing of the vessel, as the termination of the common femoral or popliteal in the lower extremity or the axillary in the upper, and, there blocking up the vessel, occasion sudden gangrene of the limb. When thus broken up and circulating they form *embola* (Vol. I., p. 721). If one of these embola be driven into a visceral artery, structural changes in the part supplied by the vessel will necessarily ensue; and if the organ be one immediately essential to life, as the brain, instantaneous death may be the consequence of this plugging of one of its arteries by a fibrinous mass formed at and carried from a distant part of the arterial system.

The subjects of plastic arteritis and of embolism are so intimately associated that it becomes in the highest degree difficult to separate them, and in many cases, when an artery is plugged by a plastic mass with imbibition of and effusion into its coats, to say whether the fibrine of the blood has become adherent to and almost incorporated with the coats of the vessel in consequence of primary changes of an inflammatory nature taking place in them; or whether the converse has been the case, and the primary change has taken place in the blood, the alterations in structure in the arterial walls being secondary to these. But it is not easy to understand how or why impure or diseased blood should select one particular limited patch or spot in the arterial system upon which to deposit its coagulum or fibrine, unless there have previously been such changes of structure, inflammatory or otherwise, at this point of the arterial walls as to dispose the blood to stasis at this point, and to deposit of adherent blood-clot on the inner coat of the artery. In the absence, therefore, of any such structural changes as atheroma or calcification of the coats of the vessel itself, it is more than probable that a primary change of an inflammatory character has been set up there, in consequence of which the thrombosis and subsequent embolism have resulted as secondary consequences.

The changes that take place in the artery at some localised spot may commence either in the external or in the internal coat of the vessel. The Surgeon is familiar with both these as starting-points for plastic arteritis. Thus, if an artery be contused (Vol. I., p. 265) in an external wound, the inflammatory irritation in which it participates in common with the other injured structures may determine the thrombosis of the vessel. The same will happen in cases in which an artery has been cut down upon and exposed without being tied, or where a temporary ligature has been used.

**Plastic arteritis** as a consequence of inflammatory action, beginning in the inner coat, is of daily occurrence in surgical practice, when a large artery has been tied (Vol. I., p. 294).

Any external agency, then, that is sufficient to produce inflammation in the external or internal coats of an artery, will be sufficient to determine in the artery that condition in virtue of which the blood circulating through it deposits its fibrine upon its lining membrane at the seat of injury, and thus the foundation of a thrombosis.

SECONDARY EFFECTS OF ARTERITIS.—These are of great importance.

**Arctation**, or even complete **occlusion**, of the artery not unfrequently occurs, as a consequence of inflammation of the vessel. This usually results from chronic arteritis, often excited by the pressure of a tumour or by some other local irritant. As it is usually a slow process, there is abundant time for the anastomosing circulation to be set up: so that the vitality of the limb or part supplied by the diseased vessel is preserved. The artery that has been so narrowed and closed, ultimately becomes converted into a fibro-cellular cord up to the nearest collateral branch, just as if it had been occluded by a ligature.

The thrombosis which renders the vessel impervious by obliterating it, may in some cases give rise to *gangrene* of the parts supplied. This is especially apt to occur if the arteritis be acute, if the patient be aged, or if the plug be so situated as to occlude some of the principal anastomosing branches, so that there may not be time or opportunity for the collateral circulation to establish itself. In other cases, fibrine may not only be deposited at the part inflamed, but may, in the form of embola, be carried lower down than the original seat of disease, and thus accumulate in the terminal branches of the artery. The vessel will thus be obstructed at two points, between which a pervious part will be included. This double occlusion of the vessel, I believe, renders gangrene of the limb inevitable; at least, in all those cases in which I have seen mortification result from arteritis, this condition has existed.

The fibrine poured out at the inflamed point may in some cases be carried on through the terminal branches of the vessel into the capillaries, and thus may form buff-coloured *deposits in various organs*, especially in the spleen. In other cases, the arteries and capillaries of a tract of tissue being thus plugged by embola, the blood in the veins leading from the part will coagulate; and this coagulation, spreading into veins beyond the part primarily affected, will cause thrombosis of some larger veins. Should a piece of the thrombus projecting into a vein become detached, it will be carried on in the circulation until arrested at some point, as in the lungs, or, being arrested in and obstructing a venous trunk, it may give rise to so-called phlebitis.

SYMPTOMS.—The **Local Symptoms** of arteritis depend not only on the condition of the vessel itself, but on that of the parts which it supplies. The most marked are pain; some tension and stiffness of the affected limb; a good deal of tenderness; and a cord-like feeling along the inflamed vessel, in which also a jerking and forcible pulsation can be felt. The *pain* below the part of the artery that is inflamed, is always very severe, and is distinctly of two kinds—superficial and deep. The *superficial* pain is seated in the skin, which is excessively sensitive to the touch, so that the patient cannot bear the finger to be laid upon it, just as is the case in neuralgia; it is smarting and pricking, and, is, I believe, always associated with more or less loss of muscular power. The *deep* pain is burning and lancinating, and not only follows the course of the vessels, but strikes through the limb in different directions. If the inflamed part of the vessel be not completely occluded by the plastic plug deposited in it, the *pulsation* in the arteries of the limb, below the seat of the disease, may continue much as usual; but in the majority of cases the pulsation ceases in all the vessels on the distal side of the inflamed spot, and the limb gradually loses its temperature, becoming of a dark or livid colour, and cold; yet the inordinate sensibility of the surface continues. As the *gangrene* advances, however, this is lost; the parts, at the time that they lose their sensibility, assuming the ordinary character of dry, shrivelled, or mummified gangrene, until all indications of vitality cease. If, however, the veins be plugged, as well as the arteries, the dark moist variety of mortification will result. In this way some of the cases of so-called "spontaneous gangrene" are occasioned (Vol. I. p. 661).

The **Spontaneous Gangrene** resulting from arteritis may occur in the upper as well as in the lower extremities, and is not unfrequently met with in young people. In most of the cases which I have seen, it has occurred in individuals under the age of thirty. When it is the result of pure arteritis, independent of any other structural affection of the coats of the vessel, the gangrene most commonly occurs in the upper extremity. Arteritis, however, is by no means necessarily followed by mortification; the liability to the loss of vitality depends on the seat of the inflammation, being greater when it takes place in the neighbourhood of the large collateral trunks of the limb, and when it is of an acute character, so that the anastomosing circulation has not time to establish itself. It also occurs more frequently when the arteritis is idiopathic than when it is traumatic; as then a larger extent of vessel is plugged, and there is a greater tendency to the occlusion of the collateral branches, which are necessary to the preservation of the vitality of the limb. The embolism of the terminal branches, by the plastic matter poured out at the seat of inflammation and washed down into the lower part of the limb, is a frequent cause of gangrene.

### STRUCTURAL DISEASES OF ARTERIES.

An artery may be the seat of various **Structural Lesions**, which play an important part, not only in giving rise to ulterior diseases in the vessel itself, but in disposing to various affections of the organs which it supplies. If we look upon an artery as a tube composed of tissues that differ largely in their organisation and structure, we must necessarily consider their diseases to be equally varied; and we shall find that, whilst the changes which take place in the external coat, in which the whole of the vital or nutritive activity of the vessel resides, are chiefly conservative, those that have their seat in the internal and middle coats have a destructive tendency. This important difference in the character of the diseases of the coats of the vessel, is dependent on the relative degrees of vascularity and of vitality possessed by these structures. The diseases of the internal coat are the most interesting in a pathological point of view; those of the external coat in a practical one.

The coats of an artery are liable to the following changes:—1. Plastic Deposit on and under the lining membrane; 2. Fatty and Granular Degeneration; and 3. Calcification.

1. PLASTIC DEPOSITS on the free surface are of a fibrino-albuminous character, occurring in the form of rounded, semi-transparent, and glistening masses, usually met with in the aorta or larger arteries around the mouths of their secondary vessels, or of aneurismal sacs—not unfrequently appearing to be agglomerated on calcareous spicula, and attaining great thickness. They

are almost structureless, gelatinous, sometimes rosy-looking, and cut with a hard cartilaginous section. This plastic deposit appears to come mostly from the circulating blood, to simulate, when membranous, so closely in structure to the lining membrane of the artery as scarcely to be recognisable from it, and not to be an inflammatory product. The plastic deposits on the attached surface of the lining membrane are opaque, semi-transparent, yellowish-white, elastic but hard masses, composed essentially of plastic matter with some oily globules intermixed. These are subinflammatory.

2. Fatty and Granular Degenerations.—These are of the most interesting character, and play an important part in arterial diseases. They occur under the different forms of *Atheroma*, either in the arterial coats themselves, or in the plastic deposits upon or underneath them.

*Character.*—The atheromatous deposits occur in very different forms, according to their age, &c. Their first appearance is in the shape of fine white opaque streaks, situated in the substance of the lining membrane of the artery. As such, they are most commonly met with in the upper part of the arch of the aorta and in the neighbourhood of the orifices of the large arterial trunks; especially along that part of the vessel from which the intercostals arise. Here they may be seen at a very early age. I have met with them in children of three, five, or seven years old. As the disease advances, these streaks aggregate together so as to form a large, white, and opaque patch. The middle coat now becomes thinned by the pressure of the patch, and, from being yellow and elastic, is altered into a grey, semi-transparent, and inelastic membrane, which often becomes stained by imbibition with blood, and presents a condition which corresponds to the "steatomatous deposit" of Scarpa and Hodgson. In the third stage the patch softens, becoming converted into a pultaceous or cheesy mass, and even sometimes undergoing complete liquefaction into a yellow creamy fluid, which has often been mistaken for true pus. These changes will be found to be mainly dependent on the abundant formation in it of fat-globules and scales of cholesterine. The softened atheromatous patch will be found to be situated in a kind of pouch or depression in the internal or middle coats of the artery, usually of a more or less oval shape.

At the same time when the changes just described are going on in the coats of the vessel, an important alteration is taking place in the connection between the internal and middle coats at the edge of the atheromatous patch: here they become firmly incorporated together by inflammatory action, so that the one cannot be peeled away from the other, and the diffusion of the softened atheroma between the two membranes is arrested. Thus also, when the internal coat is completely eroded, and when the atheroma is washed away by the current of the circulation, the infiltration of the blood between it and the middle coat and out of the pouch thus formed in the walls of the artery is prevented.

These changes in the internal and middle coats of the vessel are destructive, and tend to its rupture; but, coincidently with these, the external coat becomes thickened and indurated by the deposit of plastic exudative material, which becomes developed into connective tissue, thus strengthening the softened and weakened artery by the formation of a new layer of tough and firm tissue on its outside. It is especially opposite the deeper and more eroded atheromatous patches that this consolidation of the external coat takes place, thus preventing the perforation of the artery in this situation. This change, which is undoubtedly inflammatory, is strictly conservative. The new deposit is not confined to the external coat of the artery, but extends to the sheath of the vessel, and, by soldering it to the contained artery, greatly adds to the strength of the vascular walls.

Thus in these diseased arteries a process of repair or rather of strengthening takes place in two directions. In the interior of the vessel the lymph-masses that are deposited there act as breakwaters lessening the force of the impulse of the blood against, and directing its current away from, weakened parts of the arterial walls; whilst these in their turn are strengthened from without by the consolidation and thickening and incorporation of the external coat and sheath by exudative material.

**Atheroma** essentially consists, as was first pointed out by Gulliver, of a fatty and granular disintegration of the arterial coats; the transformation into fatty and granular matter taking place both in old fibrinous deposits upon and in the internal and lining membrane itself. The atheroma when fully formed consists of granules, oil-globules, and cholesterine, in various proportions Figs. 345, 346), the plates of cholesterine being largest and most abundant in those cases in which the atheroma is the softest (Fig. 347). The primary seat of the changes is the lining membrane of the vessel, in the outer layer of which, corresponding to Henle's *fenestrated coat,* they are first met with, as I have often observed, after macerating and dissecting diseased arteries.

That atheroma consists essentially in a fatty and granular degeneration of a portion of the arterial wall there can be no doubt. With this degeneration inflammatory products are found associated. The questions have hence arisen, Is atheroma the result of the inflammatory action that has given rise to these products? Or is the atheromatous degeneration the primary disease, and the evidences of inflammation secondary to it?

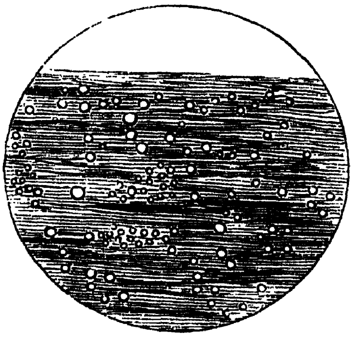


Fig. 345.—Fatty Deposit in Internal Coat.

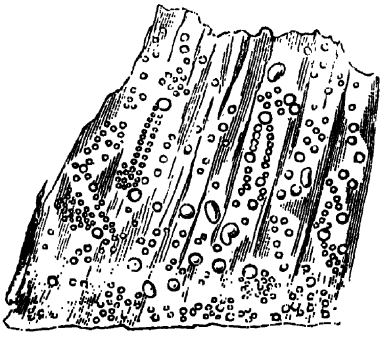


Fig. 346.—Early Stage of Atheroma.

The older pathologists, judging of softened atheroma simply from the naked eye characters and appearances, looked upon it as a kind of pus, and referred its presence to a pre-existing inflammation. The microscopic researches of Gulliver demonstrated the fallacy of this view of the deposit; and, as has already been stated, he showed that the soft and semi-diffluent atheromatous deposit was composed essentially of granular and fatty matter and more or less cholesterine—that it was, in fact, the result of disintegrating changes in the arterial coats, and not an inflammatory deposit. More modern observers have confirmed Gulliver's view of the essential character of fully formed atheroma, but incline to the opinion that its formation is preceded by change in the arterial coats of an inflammatory character, or at all events by such changes as lead to the development of proliferating connective tissue cells. Virchow and Billroth in Germany, and Moxon in this country, have particularly insisted on the pre- or co-existence of such changes in and with atheromatous deposits. It would be altogether beyond the scope of a practical work such as this, to enter at length into the discussion of so purely a pathological question. But, as it has important bearings on the early stages of aneurism, it may be briefly considered. Much will depend on what is meant by *atheroma*. English Surgeons have applied this term to those changes that have just been described at whatever age and under whatever circumstances they occur. If we adhere to this definition of atheroma, we shall find that it presents itself under two forms. One is sometimes found in very young subjects on the surface of the inner coat. In this the deeper layers of the internal coat are not affected, and the change appears to be simply one of fatty degeneration, usually to a very limited extent, without the previous occurrence or the coexistence of any inflammatory action or the development of any product of such action.

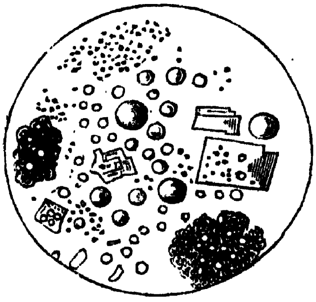


Fig. 347.—Atheroma, with abundant Cholesterine.

In the other and more usual form of atheroma, we meet with much more extensive changes of structure in the arterial tissues; and it is to this form of the disease that the descriptions of those pathologists who advocate the inflammatory origin of atheroma more especially apply. In these cases the inner coat becomes greatly thickened and swollen in patches, presenting a bluish-grey semi-opaline appearance in some parts; in others, patches and streaks of a dull yellow or buff-coloured atheromatous deposit. On making a transverse section of an artery thus affected, the external and middle coats will be found healthy; but the inner coat, healthy in some parts, becomes greatly thickened in others. This thickening—sclerosis—is due to a free proliferation of connective tissue cells with increase of the fibroid material. These cells in the deeper layers become transformed into little masses of oil-granules, which, by their subsequent disintegration, give rise to a pulpy débris of large and small oil-globules floating in an albuminous fluid and containing crystals of cholesterine (Fig. 347). The deepest layers of the inner coat adjoining the middle coat are also very granular, but not wholly broken up; and the granular change may even extend slightly into the nearest layers of the middle coat.

The accompanying diagram (Fig. 348), for which I am indebted to the kindness of H. Arnott, illustrates these conditions well.

Moxon, after a careful study of atheroma, comes to the conclusion that it is essentially a subinflammation in various degrees of the arterial coats—the lower degrees ending in fatty degeneration both of coat and of inflammatory product.

**Syphilitic Deposits** in and consecutive degenerations of the coats of arteries are of common occurrence, and may lay the foundation of aneurism. These syphilitic deposits in the coats of arteries must not be confounded with ordinary atheroma. They partake of the general character of the syphilitic gummata, and are most commonly met with in the large vessels. They involve the external coat, or may be deposited in plastic masses on the lining membrane.

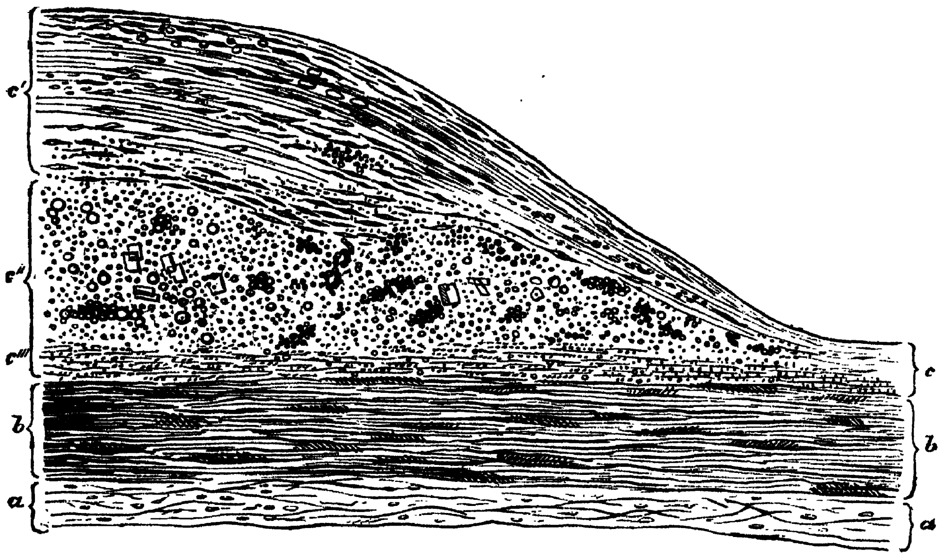


Fig. 348.—*a*. External Coat. *b*. Middle Coat. *c*. Internal Coat.
*c'*. Sclerosing Layer of Inner Coat, showing abundant Cell-proliferation.
*c''*. Atheromatous Matter derived from Fatty Metamorphosis of Proliferated Cells, Oily Débris, softened Tissue-elements, and Cholesterine.
*c'''*. Deepest Layers of Inner Coat, fatty but not wholly disintegrated.

*Effects.*—The most important consequence of these changes in the structure of the artery is the effect produced upon its vital properties. Instead of being an elastic resilient tube, reacting on the contained blood and serving to regulate its distribution, it becomes inelastic, and consequently either gradually dilates in its calibre under the influence of the outward pressure of the blood contained within it, forming perhaps an aneurism; or, being incapable of regulating the distribution of the vital fluid, tends to impair the supply to the organs to which it leads, and thus may occasion impairment of nutrition leading to softening, disintegration, or mortification.

3. Calcification of Arteries comes next in order of frequency to their fatty disintegration. This change consists in the deposit in their coats of a quantity of hard and gritty earthy and saline matters, which, though commonly called osseous, present none of the true characters of bone—no trace of bone-corpuscles or of vascular canals being ever traceable in them. Microscopical examination shows them to consist of an irregular crystalline granular mass, without any evidence of organisation, composed, according to Lassaigne, of 50 parts of animal matter, 47½ of the phosphate, and 2 of the carbonate of lime in every 100. This calcification of the arterial coats is closely allied to atheroma; and indeed it would appear to have the same starting-point in many cases at least; the new growth preceding the atheroma having undergone

calcareous instead of fatty degeneration. The deposit always takes place in the first instance in minute sabulous grains or granules; these after a time coalesce, assuming different forms according to the seat of the deposit and the age of the individual.

**Laminar Deposit.**—This is the most frequent, and is principally met with in the larger arteries, such as the aorta, the iliac, and the carotid. In this variety, calcareous masses and plates of various sizes, from a grain-like sand to a shell-like plate an inch in width, are met with in these vessels. The thickness of the patch varies from that of silver paper to two or three lines. The shape is elliptic or triangular, the largest diameter being in the direction of the axis of the vessel. The edge of the plate is ragged, rough, and uneven, and the surface smooth and incurvated towards the cavity of the artery; if large, it is usually fissured or cracked, and surrounded by much atheroma. These patches are situated in the longitudinal fibrous coat, and are chiefly deposited where this structure abounds, as at the arch of the aorta, the bifurcation of the iliacs, and in the carotid arteries. The inner coat is usually thickened and opaque where it covers the patch, and the middle much thinned and wasted.

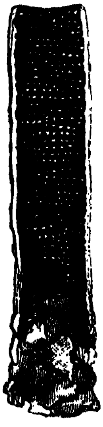


Fig. 349.—Annular Calcification.

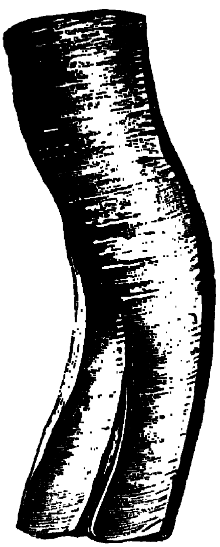


Fig. 350.—Tubular Calcification.

**Annular Calcification** principally occurs in arteries of the third magnitude, such as the popliteal and the femoral. It commences by the deposit of granules of calcareous matter (Fig. 349), which are arranged in lines running transversely to the axis of the vessel; these lines gradually increase in breadth until they coalesce laterally, the intervening spaces being filled up, and the vessel being converted into a rigid tube. This form of calcification I have found to occur in the transverse fibres of the middle coat. Billroth believes it to commence in the muscular fibre-cells of the middle coat. It is accompanied by but little atheromatous matter.

**Tubular Calcification** appears to be an increased degree of the varieties just described, the arteries being converted into pipes or tubes of calcareous matter, with the exception of a few threads and patches, and some atheroma deposited in the coats (Fig. 350). It is especially the tibial and coronary arteries that are liable to this kind of transformation. When an artery has thus been converted into a tube of calcareous matter, masses of pale, opaque, waxy-looking fibrine are deposited in it, and may block it up more or less completely. These masses not uncommonly undergo subsequent atheromatous degeneration.

The various forms of fatty and calcareous transformation of the arterial coats that have just been described, are constantly found associated together in the vascular system of the same individual, and often indeed in the same vessel. It has been pointed out by Bizot that the symmetry of the arrangement of these morbid appearances in the corresponding vessels on opposite sides of the body is remarkably great, the arteries of one limb being often the exact counterpart in this respect to those of the other.

**Causes.**—The frequent co-existence of these various morbid changes in the same portion of the arterial system points to their origin from one common cause, under the influence of which the coats of the vessel may become converted into either fatty or calcareous matter. It is quite evident that these are *retrograde metamorphoses,* to which all fibrous tissues are especially liable under the influence of a disturbance or diminution in the normal nutritive activity in the part. And, indeed, any circumstance that induces a depravation of healthy assimilation in the system generally, will speedily tend to occasion a transformation of the texture of the more lowly organised tissues into products still lower in the scale of organisation: and this will more readily and certainly take place if any localised inflammatory attack have been developed. Under such influences, the fibrous tissues of which the arterial walls are composed rapidly undergo disintegration, and conversion into fatty, granular, and earthy matter.

That influence under which the vital forces of the system are most commonly diminished in activity is *old age;* and this diminution may be looked upon as possible at any period after the organisation has reached its full maturity, whether this be early or late. So frequent, and indeed constant, are these transformations of the arterial coats during the decline of life, that they may be considered as the natural result of the diminution of the nutrient activity consequent upon advance in years. Gmelin has found that there is a progressive increase in the earthy matters contained in the coats of healthy arteries as the individual advances in life. Thus he has ascertained that the ash of the arteries of a newly born child yields 0·86 per cent. of phosphate of lime; the healthy arteries of an adult 1·25; and those of an old man 2·77 of the same salt; whilst the calcified arteries of an aged man contain 4·01. There is no precise period of life at which these changes set in: age is a relative term, and, so soon as the system has passed its full maturity, in whatever year of life this may happen, there is a tendency for these deposits to take place in considerable quantity. These senile transformations, therefore, can scarcely be looked upon as pathological changes in many instances. But the same process of degradation of tissue may commence at any, even the earliest periods of life, under the influence of causes that impair the vital forces.

The **Constitutional Causes** that thus dispose to or directly occasion degeneration of the arterial system are those that lead to defective organisation or to direct impurity of the blood, such as the various forms of chronic kidney-disease, gout, and syphilis. To the influence of syphilis, more especially in its advanced and constitutional forms, Aitken attaches great importance in the production of atheroma. It is easy to understand how these various diseases may exercise a double deteriorating influence on the arterial walls; *first,* by the direct impairment of their nutrition in common with that of the fibrous textures of the body generally; and, *secondly,* by the circulation through them of blood surcharged with morbid matters, which, by irritating their lining membrane, may induce low forms of inflammation of their coats. It is, as has been already stated, a favourite supposition with many pathologists, that these changes result directly from inflammatory action; this certainly does not always appear to be the case, but that it often is so, is by no means improbable. An artery in which inflammation has taken place may have its nutrition so modified as to become more susceptible to early and extensive degeneration, the plastic matters thrown out being especially liable to undergo changes leading to conversion into fat and calcareous matter.

Some arteries are more liable to these structural lesions than others; and the *relative frequency* of the various forms of deposit varies in different arteries. Thus the ascending aorta is most subject to fatty degeneration, whilst the calcareous transformation is most frequently met with in the arch and abdominal portion of the vessel. The arteries of the lower extremities (viz., the femoral, the popliteal, and the tibials) are chiefly affected with calcareous deposits, whilst the fatty are commonly met with in the vessels of the brain; and some arteries appear to be exempt from disease; thus, Tiedemann states that he has never found the œsophageal arteries ossified. The difference in the liability of different arteries to disease is, no doubt, in a great measure, to be accounted for by the different degrees of development of the longitudinal fibrous coat in different parts of the arterial system—this being, I believe, in most instances the primary seat of the affection. Thus, in the aorta, the coronary arteries, and those of the brain, in which it abounds, we find these transformations frequent. The distance of the tibials from the centre of circulation, and the consequent diminished nutritive activity of their coats in old people, may account for the frequency of their degeneration. Those points of the arteries, likewise, upon which the shock of the onward wave of blood is most directly received, are more subject to degeneration than neighbouring parts of the continuity of the wall of the vessel. This is especially observable at the origins of the arteries that spring from the arch of the aorta, and at the bifurcation of the iliacs, the popliteals, &c.; in fact, at all parts of the arterial system on which great pressure may be thrown, and where the vessels may consequently be overstrained. It is also not improbable that the increased pressure of the blood upon the coats of arteries that lead to diseased organs, through which the circulation is obstructed, may tend to their degeneration, and eventually to their rupture.

**Sex** exercises but little general influence on the liability to disease in the arterial system, though it specially tends to the occurrence of those changes in certain arteries. Thus Bizot states that the arteries of the upper extremity are most frequently diseased in women, and those of the lower in men, and Moxon states that amongst women it is most common in those who follow laborious employments. Amongst men, also, those who are subjected to great strains in their work, more especially if that strain be intermittent as well as violent, are more liable to degeneration of the coats of the arteries.

**Local Effects.**—The structural lesions that have just been described produce certain local effects, often of considerable importance, on the parts which the affected vessels supply with blood. For the proper and healthy nutrition of a limb or part to be carried on, two great conditions are required, so far as its arteries are concerned:—1, that the integrity of the structure of the walls of the vessels continue perfect; and, 2, that their channels remain pervious: for, although the arterial system possesses remarkable conservative powers in its arrangement and distribution that tend to counteract these effects, yet, by slow degrees, a deterioration of function and disintegration of structure take place in the part immediately supplied by the diseased vessel. Thus, in the limbs, we have all the signs of a defective circulation—coldness of the feet, cramps, and spasms of the muscles; whilst, in organs, softening of tissue, fatty degeneration, and other evidences of the want of a proper supply of blood leading to impaired nutrition, manifest themselves.

FURTHER STRUCTURAL CHANGES IN ARTERIES.—Beside the changes that take place in the parts to which the diseased arteries are distributed, ulterior effects are produced upon the vessels themselves, which may lead to important consequences. These consist in Ulceration of the Coats of the Artery; their Spontaneous Rupture; Contraction or Occlusion of the Interior of the Vessel; and, lastly, its Dilatation into some of the various forms of Aneurism.

**Ulceration of Arteries,** though frequently spoken of, in reality seldom occurs; the so-called ulceration being in general an erosion occasioned by a patch of softened atheroma and its investing membrane having been carried away by the current of blood, which then washes the base of the depression thus produced in the middle coat, but is prevented from extending between the coats by the process of inflammatory fusion and cohesion which has taken place in them around the patch. This apparent ulcer is deepened by the deposit around its margin of fibrine from the circulating blood, often in large gelatinous-looking masses. When true ulceration of an artery takes place, it is by destructive action commencing from without, attacking first the external coat, and not by any of the disintegrating processes commencing within the vessel.

**Spontaneous Rupture** of an artery is rare, and never happens without previous disease of its coats. Experiments made by Peacock, which I have repeated, and the accuracy of which I can fully confirm, prove that a healthy artery will sustain a very great pressure from water injected into it, without its walls giving way. But, if these have been softened or weakened by disease, they may be unable to resist even the ordinary impulse of the blood; and if this be driven on by any unusually forcible action of the heart, as under the influence of sudden violent strain or exertion, they may give way. This occurrence would be much more frequent than it is in atheromatous and calcareous patches, were it not for the inflammatory consolidation of the external coat of the vessel supplying that resistance which has been lost by the softening or destruction of the internal and middle tunics. Hence this rupture is most frequent in those vessels the outer coat of which is thinnest, and in which, consequently, it can least supply the place of the others, as in the arteries of the brain and in the intrapericardial portion of the aorta. The liability to rupture of a diseased artery by the distensile force of the blood impelled into it, is greatly increased by the existence of an obstacle to the free flow of the blood out of its terminal branches in consequence of a congested, infiltrated, or chronically thickened state of the organ or part supplied by it.

**Contraction and Occlusion** of arteries are by no means rare sequences of the structural lesions of these vessels. We have already seen that these conditions may arise from inflammation of the coats in any way excited, as by the pressure of tumours; but, besides this, the structural changes that take place may produce narrowing and closure of the vessel in various ways. Thus the diseased patch may project into the artery in such a manner that plastic matter and coagulum are gradually deposited upon it, until the interior of the vessel is blocked up; or the irritation of the morbid products may give rise to chronic inflammation in the coats, occasioning contraction, the effusion of lymph, and consequent occlusion. In one or other of these ways, arteries of all magnitudes may be gradually narrowed and at last completely closed; and yet the patient may survive, and the parts supplied by the obstructed vessel may maintain their vitality, in consequence of the collateral circulation being sufficiently active to keep up the supply of blood to them. The vessels that are most frequently blocked up in this way are the tibials; next to these perhaps the carotids; the other arteries are but rarely so occluded. Yet many instances have been collected by Tiedemann of this morbid process affecting most vessels, but more especially the iliac, the brachial, and the axillary arteries, and the different branches of the abdominal aorta. Tiedemann records from various sources no fewer than eight cases in which the abdominal aorta was completely closed, in all of which so full and efficient a collateral circulation had been set up, that the vitality of the lower part of the body was perfectly maintained and in most the morbid state was not suspected during life. Besides these cases, he states that there are on record twelve instances of great narrowing of the aorta, at that point where the ductus arteriosus is implanted into it in fœtal life. These would appear in some way connected with the closure of the duct; as in every case the indentation was greatest on the convex part of the aorta, which had been drawn in towards the mouth of the duct, as if the vital contractile force necessary for the closure of this had extended itself to the aorta, and produced a similar action in it.

When any of the arterial narrowings or occlusions occur in a gradual manner in early life, or in a part where the collateral circulation is free, no ill effects result; but in an opposite condition the interference with the circulation leads to the death of the part supplied by the diseased vessel. This is particularly the case in the lower limbs of old people, where the circulation is extremely feeble, both as the effect of age and in consequence of the distance from the heart; and it is in this way that the true senile gangrene or mummification of the limb occurs. The symptoms and treatment of this affection have already been adverted to (Vol. I., p. 662); but it may be here stated that, whilst some have considered the gangrene as entirely the result of arteritis and embolism, others look upon it as consequent on the occlusion of the vessel from disease of its coats; and each party has laid down principles of treatment in accordance with its view of the pathology of the affection. From what has preceded, it would appear that the arteries of a limb may be occluded, and that, consequently, gangrene may result from either condition. The occlusion from arteritis, followed by gangrene, most frequently occurs in the upper extremities, and in young or middle-aged people, and is preceded by local and constitutional symptoms of inflammation; and the artery presents on examination the true embolic plug. The occlusion from calcification and atheroma chiefly occurs in the lower extremities, and in old people: it is preceded by a rigid condition of the vessels—by cold feet, cramps, numbness, and weakness of the legs; and, after removal, the arteries will be found to be converted into rigid unyielding calcareous tubes, with some deposit of atheroma, and with waxy-looking masses of fibrine filling up their interior. Besides these two distinct forms of the disease, there is a third and very common variety, in which a low form of inflammation takes place in previously diseased arteries, and in which we find a combination of the two conditions.

**Treatment.**—With regard to the treatment of narrowing or occlusion of the arteries, unconnected with gangrene, I have little or nothing to say ; except that, if there be reason to suspect such occurrence in a limb, care must be taken to keep the part warm by means of appropriate clothing, and if there be much pain, to allay this with opiates. If gangrene have come on, it must be treated with reference to its cause. That connected with arteritis and embolism has already been discussed (Vol. I., p. 667) ; but when it occurs from structural disease of the coats of the vessel, then the treatment must be directed by the existence or absence of any complicating inflammation, in accordance with those principles that have been laid down in discussing the general management of gangrene.

# CHAPTER XLIII.

## ANEURISM.

By **Aneurism** is meant a tumour, resulting from the dilatation of the whole or a portion of the coats of an artery caused by the contained blood, and communicating with the interior of the vessel.

CAUSES.—The causes of aneurism are divisible into those that predispose to, and those that excite the disease. Aneurism is **Predisposed** to by any affection of the arterial coats that lessens the elastic resiliency of the vessel, and at the same time weakens its resisting power. When the arterial walls have undergone more or less *fatty or atheromatous degeneration,* whether that consist in the distinct deposit of patches of atheroma, or of molecular deposit of fat-globules in the tissues composing their coats, their natural elasticity and resiliency become lost, proportionately to the amount of subinflammatory and fatty change that has taken place within them. Hence as the artery becomes less and less able to contract on its contents, and to recover during the diastole from the tension exercised on its walls during the systolic impulse, it gradually becomes distended by the repetition of the shocks which it sustains, and thus either complete or partial dilatation of its cavity takes place. I believe that this loss of elasticity and of power of contracting on its contents, which eventually results in the dilatation of the vessel, never occurs except as the result of previous disease of the coats. In the very numerous specimens of dilated arteries that I have examined, I have never found one that had not undergone fatty degeneration, or atheromatous deposition. Calcification, on the other hand, rather prevents than favours dilatation of the artery, by hardening the coats and converting them into rigid inelastic tubes ; but atheroma softens them, and causes yielding of that portion of the vessel affected by it. I have frequently observed that the whole of the artery might be healthy except at one part, where there was an atheromatous patch, and where the vessel was dilated ; or that the whole of its coats might be calcified except at one spot, where atheroma was deposited, and where consequently the coats had yielded under the outward pressure of the contained blood.

As aneurism, therefore, may be looked upon as one of the sequences of atheroma, or at least as being invariably preceded by that form of arterial degeneration, the predisposing causes of the one condition must necessarily be the same as those of the other. Hence we find that age, cachexy, and syphilis influence the occurrence of the aneurismal disease by laying its foundations in the formation of the atheromatous deposit.

**Age** exercises a powerful predisposing influence on the occurrence of aneurism. It is during the middle period of life, about the ages of thirty and forty, that aneurisms are most frequently met with ; at those ages, indeed, when the arteries have already commenced to lose their elasticity, in consequence of disintegrating changes, whilst, at the same time, the heart has not lost any of its impulsive force, or the general muscular system its contractile vigour ; and when the enfeebled and inelastic vessels, becoming exposed to powerful causes of distension, may readily give way or be expanded at some one weakened point. This disease is excessively rare before puberty, yet is occasionally met with at early periods of life : thus Syme mentions a case of popliteal aneurism in a boy of seven, Hodgson had a preparation of a carotid aneurism in a girl of ten, and Schmidt a case of spontaneous aneurism of the radial artery in an infant eight weeks old.

**A forcible, irregular, and occasionally greatly increased action of the heart** is the immediate cause of the over-distension and dilatation of the vessels, and thus of the production of aneurism. Hence we find that this disease is especially apt to be induced in those individuals in whom the muscular system is called upon to make sudden, violent, and intermittent exertions ; as, for instance, in men who habitually lead somewhat sedentary lives, but occasionally and suddenly change their habits, and indulge in sports, such as hunting, rowing, or a long day's shooting, which they might without risk have practised in early life, but which cannot be taken up with impunity at an age when the arteries, having become weakened, are unable to bear the same strain upon their coats as heretofore. I agree with Porter, in thinking that continuous, steady, laborious employments do not predispose to aneurism, as this disease is seldom met with amongst those of the lower classes who labour hard and uninterruptedly ; but it rather occurs in those who, after long periods of comparative inaction, are occasionally and suddenly called upon to make very violent muscular efforts, disproportioned to their strength, or, at all events, to their previous habits. It is in this way that soldiers, sailors, and members of the higher classes in society, are rendered peculiarly liable to aneurism. As violent muscular strain and exertion predispose to this disease, we should necessarily expect to meet with it more frequently among men than in women ; and accordingly, Crisp finds that, of 551 cases of aneurism of all kinds, more than seven-eighths occurred in men. It is important, however, to observe that different kinds of aneurism occur with varying degrees of frequency in the *sexes:* thus, this affection is met with in the carotid artery about as often in women as in men, whilst the other external aneurisms occur in the proportion of thirteen cases in males to every one that happens in a female. It is remarkable, however, that in the dissecting aneurism the proportions are reversed ; for every one case in men, two occur in women.

**Climate** exercises an important influence on the occurrence of aneurism, which is far more frequent in cold than in hot countries. It is not, however, the geographical position or the meteorological state of a country that exercises any direct influence over the occurrence of this disease. It is in reality the habits of the people that dispose to it, and that regulate its prevalence ; and it is in the more energetic nature and the more active physical habits of the northern nations that we must look for an explanation of its greater prevalence amongst them, than in the more indolent inhabitants of the South. If we may judge of the prevalence of aneurism in a country by the number of published reports of cases, I should say that it is of more common occurrence in Great Britain and Ireland than elsewhere ; indeed, Roux states that it is less frequent in France than in England. In America, it is also of frequent occurrence ; but in the East Indies it is comparatively rare.

**Cachexy** induced by any cause, such as syphilis, chronic gout, or rheumatism, the abuse of mercury, &c., has a tendency to occasion disease of the coats of the arteries, and thus to predispose to aneurism. But, though mercury and syphilis are commonly said to tend specially to the production of this disease, I am not aware that we are in possession of any facts that would warrant us in coming to this conclusion ; though there can be no doubt that the cachexy thus induced may dispose to it as much as any other cause. It is remarkable that phthisis is antagonistic to aneurism ; though probably this may arise from the facts that the heart's action is feeble in that disease, and that violent muscular exertion is seldom undertaken by those labouring under it.

Any **obstacle to the free flow of blood** through an organ or the capillaries of a part, exercises an important influence in disposing to aneurism, as it throws an increase of pressure on the interior of the artery. Chevers believes that obstruction in the abdominal organs frequently occasions aneurisms of the abdominal arteries. Spontaneous aneurisms of the radial and ulnar arteries are supposed in the great majority of cases to be due to the obstruction caused by the impaction of an embolic clot washed on from a diseased heart.

The only **Exciting** or **Direct Occasioning Causes** of aneurism are blows, violent strains, and wounds of an artery. When an atheromatous artery is concussed by a *blow*, the lining membrane covering the softened patch may be ruptured, the atheroma being poured out into the interior of the vessel ; and thus the external coat, with perhaps a portion of the middle adherent to it, becoming exposed to the pressure of the contained blood before it has been fully consolidated by inflammation and plastic deposit, the foundation of an aneurism may readily be laid. In very violent muscular strains or efforts, it is easy to understand how an already weakened portion of the vessel may become dilated by the increased pressure that is thrown upon its interior ; and occasionally even the vessel may be completely torn across. *Wounds* implicating arteries are common causes of those various forms of aneurism that have already been discussed in considering Injuries of Arteries (Vol. I., p. 313).

CLASSIFICATION.—Aneurism may be classified as follows :—

1. FUSIFORM.—True.
2. SACCULATED.—
   - *a.* True.
   - *b* False.
     - *α.* Circumscribed.
     - *β.* Diffused.
3. DISSECTING.

1. **Fusiform** or **Tubular Aneurism.**—This is a preternatural dilatation of an artery, all the coats of which are equally expanded through the whole circumference of the vessel. It most frequently occurs in the aorta, and may, though rarely, be met with elsewhere. The fusiform aneurism is not a mere dilatation of the vessel, but there are elongation, thickening, and degeneration of its walls as well. The elongation of the artery in the fusiform aneurism is

as marked as its dilatation, and is always very considerable. Thus the arch of the aorta may attain a length of several inches, with a considerable space between the origins of the innominate, the carotid, and the subclavian, at the same time that its walls are greatly thickened, nodulated, and rugged. Sometimes several tubular or fusiform aneurisms are met with in the same vessel, with healthy portions of the artery between them. From these dilatations, sacculated aneurisms not uncommonly spring. On examining the structure of a fusiform aneurism, it will be found that it is always composed of an uniform expansion and outgrowth of all the coats of the artery, which are at the same time somewhat altered in character; thus, the outer coat is thickened, the middle rigid and inelastic, and the inner one stiffened, rugged, and tuberculated by the deposition beneath it of various plastic and atheromatous masses. No coagula, however, are found in the dilatation, but a few filamentary shreds of fibrine are occasionally seen to be attached to the inner wall. The arteries that are usually the seats of fusiform aneurism are the arch of the aorta (Fig. 351), the iliacs, the femorals, and occasionally the axillaries. This particular form of aneurism occurs most generally in vessels in which the yellow elastic coat is largely developed, and hence is rarely met with in arteries smaller than the femoral: it occurs, however, in the basilar artery of the brain.

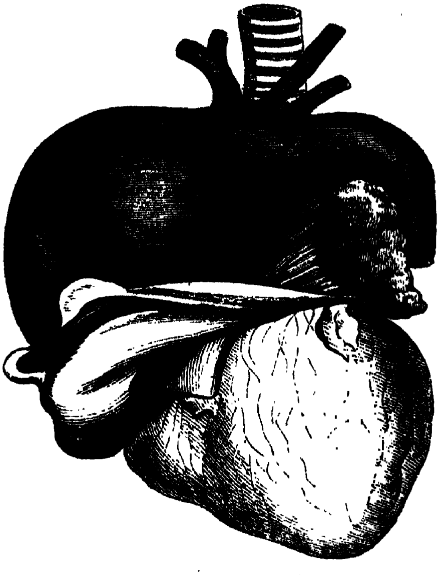


Fig. 351.—Large Fusiform Aneurism of Ascending Aorta bursting into Pericardium.

The fusiform dilatation, especially when seated in the arch of the aorta, may attain a very considerable magnitude, and may consequently exercise very injurious pressure on contiguous parts, thus producing great distress and danger of life. It is usually extremely chronic, increasing very slowly, and being compatible with existence for many years; but at last it usually destroys the patient, and may occasion death in several ways. Thus, if it be situated in the aorta, the great mass of blood in the sac may, by impeding the circulation, overpower the heart's action, so that it may be unable to recover itself, and fatal syncope may be induced. Then, again, death may result from pressure on important parts, as on the bronchi or œsophagus. In general, however, the cause of death is the giving way of a sacculated aneurism springing from the fusiform one. When, however, tubular aneurism of the arch of the aorta occupies the intrapericardial portion of the vessel, it not unfrequently happens that, owing to the absence of a sheath in this situation, the artery may rupture. It most commonly happens that a fusiform aneurism remains quiescent, being a source of discomfort, but not of death, until the sacculated form of the disease springs from its side; and then this, becoming the more formidable affection, may destroy life in some of the ways peculiar to it.

2. **Sacculated Aneurism.**—By the sacculated aneurism is meant a tumour

springing from the side of an artery or of a tubular aneurism, with the interior of which it communicates by a narrow aperture, called the mouth of the sac (Fig. 352). It is generally divided into the *True* and *False* varieties.

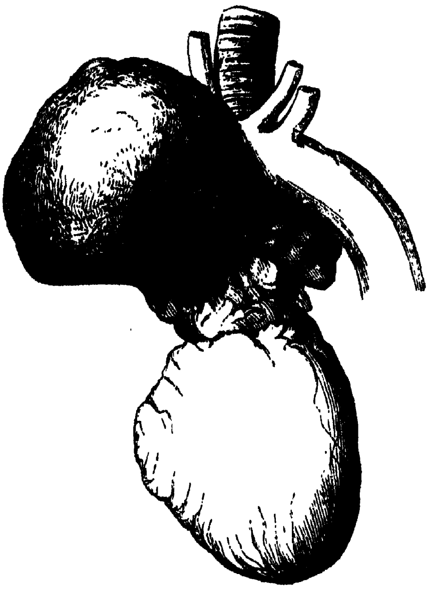


Fig. 352.—Sacculated Aneurism of Ascending Aorta. Death by Pressure.

**True Sacculated Aneurism.**—By this is meant a partial dilatation of all the coats of the vessel. Its existence has been denied ; thus Scarpa doubts the occurrence of such a disease, and Bizot seems disposed to coincide with him. With these eminent pathologists, however, I cannot agree ; and though I am willing to admit that many of the so-called "true" aneurisms are not so in reality, yet I cannot doubt, from repeated observation, that Hodgson is right in saying that in their early stages sacculated aneurisms are not unfrequently of the true kind. Thus, we occasionally find, as Peacock has pointed out, small digital pouches springing from the walls of some of the larger arteries, through the whole of which the external, middle, and internal coats can be demonstrated by maceration to exist; and in those aneurisms which are formed by the dilatation of a comparatively large portion of the arterial wall, it not unfrequently happens that the tumour remains of the true kind for some time, as I have ascertained by careful dissection. But after an aneurism has attained a certain size, its coats become so fused together, and so closely incorporated with the neighbouring tissues, that their precise structure cannot be made out. Indeed for a sacculated aneurism to be of the *true* kind, I believe that two conditions are necessary :—1, that the tumour itself be small ; and 2, that the mouth of the sac be of tolerably large dimensions. Porter says that he has never met with a *true* aneurism larger than a small orange ; and, certainly, none of those that I have seen, provided they were of the sacculated kind, have exceeded this size. In true sacculated aneurisms, also, it is necessary that the mouth of the sac, or that portion of it which communicates with the interior of the artery, should be of good size, and not bear too great a disproportion to the wall of the tumour. I cannot conceive a large sac with a small mouth to be a true aneurism ; for, as the mouth of the sac corresponds exactly in size to that portion of the arterial coats which has been originally dilated, it is not easy to understand how a large and thick sac can be expanded out of a small segment of the wall of the artery. It must be remembered that in all cases of true aneurism, however small they may be, the size of the sac greatly exceeds that of its mouth. It is therefore clear that there must have been not only expansion, but a degree of hypertrophy and overgrowth of the wall of the vessel, just as in the tubular aneurism, otherwise the sac would be thinned in the exact proportion of its expansion.

**False Sacculated Aneurism** is that variety of the disease in which the internal, or the internal and middle, coats have been ruptured, and are consequently deficient. This is by far the most frequent form of sacculated aneurism, and is that which is met with of so great a size. In by far the majority of cases, the internal coat, and the innermost layers of the middle coat, have been destroyed by atheromatous degeneration, leaving an erosion or depression in the interior of the artery, with weakness of the corresponding portion of its wall, which becomes expanded by the outward pressure of the blood. In these cases the sac is principally formed by the expansion of the outer coat, to which some of the layers of the middle may still be adherent, but which is essentially strengthened and thickened by plastic deposits, and by adhesions to neighbouring parts, which have become fused into its composition. In these cases there are outgrowth, hypertrophy, and new deposit in and upon the external coat, as is evidenced by its actually becoming thicker, instead of its being thinned, as it would be were it only expanded. The formation of an aneurism by the hernial protrusion of the internal and middle coats through an ulcerated aperture in the external coat has been described; but, though there is a preparation in the Museum of the College of Surgeons that is supposed to illustrate this fact, I doubt the existence of such a form of the disease, and after careful examination think that the preparation in question represents rather an artificial dissection than a true rupture of this dense and elastic coat.

A false aneurism may always be readily distinguished from a true one, by the greater magnitude that it attains, by the size of the sac being out of all proportion to that of its mouth, and, on a section of this being made, by the middle coat being seen to terminate abruptly in a thick and dense ring, immediately around the mouth and neck of the sac. A false aneurism may either be so from the very first, the internal and middle coats having been destroyed by softening and erosion, and the external expanded and hypertrophied into a sac; or it may originally have been a true aneurism, and have been converted into the false variety of the disease by the giving way of some of its coats.

Surgeons generally recognise two varieties of false aneurism—the *circumscribed* and the *diffused*. By the *Circumscribed False Aneurism* is meant that form of the disease in which the blood is still contained within a sac, formed by at least one of the arterial coats, however expanded and altered in its structure this may be. The term *Diffused False Aneurism* includes two distinct varieties of the disease. In one case there is rupture of the sac, with general and widely spread extravasation of blood into the areolar tissue of the limb or part. In the other case it happens that the sac formed by the dilatation and hypertrophy of the outer coat of the artery is ruptured, and the blood, although effused beyond this, is still confined in a sac of condensed areolar tissue, formed by the matter together with coagulum and lymph of the structures into which the blood has been effused.

3. **Dissecting Aneurism** is a remarkable form of the disease, originally described by Shekelton, in which the sac is situated in the wall of the artery between its coats. It originates in consequence of the internal coat of the vessel becoming eroded, and giving way before any of that adhesion and matting together of the tissues around the patch has taken place, which prevents the blood from being forced between the different tunics of the artery.

The rupture, although originating in the internal coat, always extends between the layers of the middle one, splitting this up into two laminæ, and in some cases it also separates the middle from the external tunic of the vessel. On examining the artery in a case of dissecting aneurism, its coats will always be found to be easily separable from one another, and to be very lacerable, often appearing soft and sodden as if macerated. For the production of this disease, indeed, two conditions are necessary: 1. That there be atheromatous disease of the artery, destroying a portion of the internal and of the innermost layers of the middle coat; and 2. That there be not only a want of plastic matter effused about the diseased part of the vessel, but also a general softening of the tissue of the middle coat, with want of cohesion between the different tunics of the artery: this, indeed, may be considered as the essential condition disposing to the formation of a dissecting aneurism, and causing the disease to assume this rather than the sacculated form.

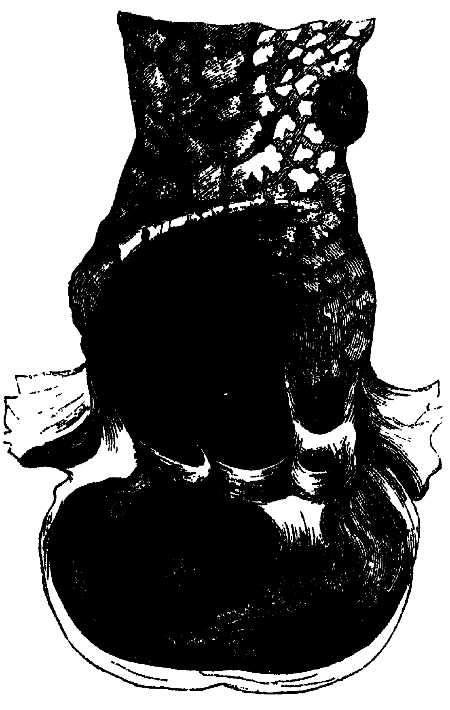


Fig. 353.—Rupture of Lining Membrane of Aorta, giving rise to a Dissecting Aneurism which burst into Pericardium. Aorta much dilated and covered with Calcareous Plates, except where the Aneurism occurred: there it was atheromatous.

The rupture constituting dissecting aneurism always takes place longitudinally along the middle coat, and may often extend to a very considerable distance. Thus it may reach from the arch of the aorta to the iliacs, or from the same part to the bifurcation of the carotids. The disease only occurs, however, in the aorta, and in its principal branches—in those arteries, indeed, in which the middle coat is highly developed, and the yellow elastic tissue abundant.

**Classes.**—Dissecting aneurisms arrange themselves into three distinct classes. 1. In one class, the blood, after having passed for a distance of several inches, or even more, through the substance of the middle coat, bursts through the external coat, and becomes effused into the areolar tissue outside the vessel and around the seat of rupture, or into the neighbouring cavities (Fig. 353). In these cases, which constitute the most common variety of the disease, death usually occurs rapidly, the patient feeling intense pain along the line of rupture, and falling into a state of syncope. 2. The external coat may become so thickened and strengthened by the deposit of plastic matter, that it resists the impulse of the blood, which consequently continues to pass between the layers of the middle coat until it meets a softened and atheromatous patch, and then again bursts into the canal of the artery. In this form of the disease, the patient may live for years after the occurrence of the rupture; the new channel that the blood has taken becoming lined with a intense smooth membrane, and resembling closely the interior of the artery, from which, however, it is separated by a kind of septum or mediastinum. The appearance here presented by the vessel has occasionally been erroneously described as constituting a double aorta. 3. The blood may find its way between the laminæ of the middle coat, but does not escape farther by rupture of the external, or by the giving way of the lining membrane of the vessel. A sac is consequently formed in the substance of the middle coat, which may become chronic, but will at last undergo external rupture.

PROCESS OF FORMATION OF AN ANEURISM.—The progression of the changes leading to the formation of an aneurism is briefly as follows. The coats of the artery undergo fatty degeneration, and atheroma is deposited at one part; this softens, and the lining membrane covering it, perhaps with a portion of the inner layers of the middle coat, becomes eroded; or the walls of the vessel may be weakened at this point without any destruction of their coats. Cohesion, however, takes place between the tissues of the vessel at the eroded or weakened spot; and the outer coat becomes strengthened and thickened by the deposition of plastic matter. Dilatation next takes place at this point; if of the entire coats, a *true* aneurism is formed; if of the eroded tunics, a *false* aneurism occurs: but if no cohesion have previously taken place between the different coats of the vessel, the blood becomes effused into and between them, thus constituting a *dissecting* aneurism.

STRUCTURE OF AN ANEURISM.—An aneurismal sac, if it be composed of a dilatation of all the coats of an artery, may be recognised on dissection by the atheromatous and calcareous deposits which are met with in the tissues of which it is composed. If it be a false aneurism, it will be found that there is little, if any, of these deposits in the walls of the sac; that the middle coat usually terminates abruptly at its mouth, and that the external coat is greatly thickened and strengthened by the deposition of plastic matter. An aneurismal sac may vary in size, from a tumour not larger than a cherry to a growth of the magnitude of a cocoa-nut or large melon. The mouth, which is oval or round in shape, varies greatly in size, being always very small in proportion to the sac. Usually the interior of an aneurismal sac contains a quantity of decolorised fibrine, arranged in concentric laminæ of but moderate thickness; these laminæ of fibrine are of a pale-buff colour, dry, and somewhat brittle where they are most closely applied to the wall of the sac; the more external ones appear to be those that are first formed, and occasionally are found to have undergone a kind of atheromatous degeneration; as we approach the interior of the vessel, they become softer and more coloured, and at last, in the central portions, dark masses of coagulum are often met with. This decolorised fibrine, called by Broca the *active* clot, proceeds from two sources. It is partly deposited from the blood which is beaten up in the interior of the sac, and thus deposits its fibrine much in the same way as when it is whipped in an ordinary vessel; this is probably the manner in which the principal masses are found deposited, and the fibrine so deposited is arranged in laminæ that take the course of the current of the blood, as in Fig. 354. In some cases, however, it would appear as if it were formed by deposition from the wall of the aneurism; for the mass, not being out of the current of the circulation, cannot well have been deposited from the blood, but must in all probability have been the result of the effusion of plastic matter from the wall of the sac; in these circumstances, there is little or any of that stratified arrangement that is observable in the fibrine which is deposited from the blood. The black blood-clot that is occasionally met with in the middle of aneurisms differs in every way from the laminated fibrine just described, and is evidently the result of simple coagulation. It is the *passive* clot of Broca. The use of the deposited fibrine appears to be in a great measure to strengthen the walls of the sac, and thus to prevent the too rapid increase of the tumour. Another great purpose that it serves is to lessen the capacity of the sac, and thus to diminish the distending force of the blood which is injected at each stroke of the heart—the outward pressure depending as much on the area of the sac as on the force with which the blood is driven into it. Then again, the lining of the walls of the sac with such a tough and elastic material as the stratified fibrine, must greatly tend to deaden and break the force of the shock of the wave of blood that is projected against what would otherwise be an unprotected and expanded membrane. In those cases in which the laminated fibrine is small in quantity or altogether deficient, the aneurismal tumour rapidly increases with a forcible pulsation that is not met with in other circumstances.

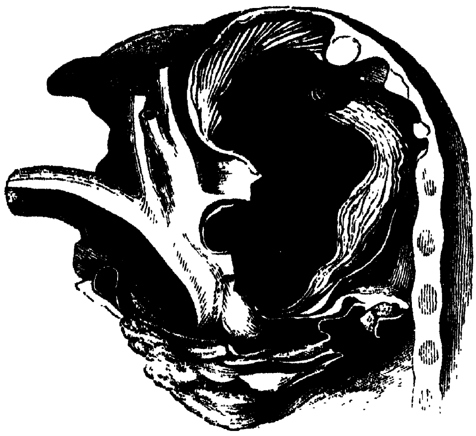


Fig. 354.—Large Aneurism of Ascending Aorta, projecting against (and protruding outwards) the ribs. Layers of Laminated Fibrine arranged in the direction of the Current of the Blood.

**Pressure-Effects.**—As the sac of an aneurism enlarges, it exercises injurious and often fatal effects by its pressure upon contiguous parts. These pressure-effects deserve attentive study, as they constitute an important and, in some instances, the sole element in the diagnosis of the aneurism.

One of the most common pressure-effects of aneurism is the occurrence of œdema of the limb or part, owing to the compression exercised by the tumour upon the large and deep *venous trunks* in its vicinity. The consequent obstruction to the venous circulation in the interior of the limb may also give rise to a distended or varicose condition of the subcutaneous vessels, and in some instances it may even go on to the production of gangrene. The pressure of the sac, also, on neighbouring *arteries*, or even on the upper part of the very vessel from which it springs, and its interference with the general capillary circulation of a part, is commonly associated with the venous compression, and may considerably increase the ill-consequences resulting from it. The pressure upon a neighbouring artery may go on to perforation of the vessel by the sac, and so a communication between the two may be set up; thus aneurism of the aorta has been known to perforate and communicate with the pulmonary artery. By its pressure upon neighbouring *nerves*, an aneurismal sac may give rise either to great pain in the part supplied by them, or to disturbance of their function; the nerves themselves becoming, in some cases, expanded or flattened out, and ribbon-like (Fig. 355), and in other instances tortuous and waving, and being considerably elongated. The pain in the nerves is often one of the earliest signs of the existence of an aneurism. The pain is usually of two kinds: it is either lancinating and radiating along the course of the nerve that is compressed; or, when the tumour presses severely upon neighbouring parts and tissues, more especially if it give rise to erosion of the bones (as in Fig. 373), an aching, burning, tearing, or boring sensation is often experienced in the part subjected to the pressure. In other cases, again, important modifications in the function of parts take place, in consequence of the pressure that is exercised upon their nerves. Thus, for instance, the compression of the recurrent laryngeal nerve will occasion hoarseness of voice and difficulty of breathing, depending on spasm of the glottis. On the *bones* an aneurism may produce very important effects by its pressure, eroding or wasting away the osseous tissue in some instances, and in others giving rise to true caries. If the bone be a flat one, as the sternum, the aneurism may perforate it by making as smooth and round a hole in it as if this had been worked by the trephine. *Glandular organs and their ducts* in the neighbourhood of aneurisms suffer the most injurious effects from the pressure of these tumours, their functions being arrested, and the passage of their secretions interfered with; so, also, by the pressure exercised on the *trachea* and *œsophagus*, respiration and deglutition may be seriously impeded.

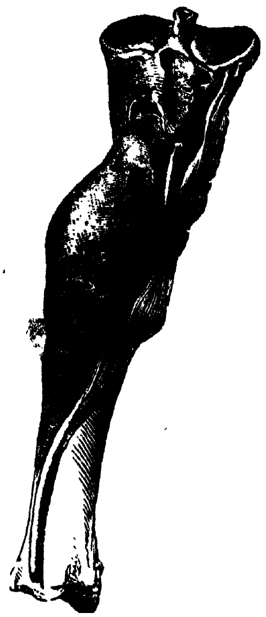


Fig. 355. — Flattening of Posterior Tibial Nerve by pressure of an Aneurism of the Calf.

NUMBER.—Aneurisms, though usually single, are not very unfrequently multiple. There may be more than one tumour of this kind in the same limb; thus the iliac and femoral arteries on the same side may both be affected. In other cases, corresponding arteries in opposite limbs are the seat of aneurism; thus the two popliteals are not unfrequently found to be the seat of this disease, and occasionally an aneurism may exist in one of the limbs, and others in the arteries of the interior of the body. When more than one aneurismal tumour occurs in the same individual, the patient is said to be labouring under the *aneurismal diathesis.* Numerous aneurismal tumours are at times met with in the same person; thus, Pelletan records a case in which no fewer than sixty-five were observed.

DURATION.—The duration of an aneurism varies very greatly. In young full-blooded persons it often makes progress with great rapidity; whereas in elderly people of feeble constitutions, or in those of a cachectic habit of body, accompanied with more or less debility of the heart's action, the disease may assume a very chronic form; thus, Hodgson relates the case of an aneurism of the femoral artery of twenty years' duration.* Much also will depend on the situation of the aneurism, the size of the mouth of the sac, and the relation of the sac to the impulse of the blood into it; the larger and more direct the mouth of the tumour, the more readily will the blood be projected into it at each impulse of the heart, and the more quickly will the tumour expand.

SYMPTOMS.—The symptoms of an aneurism are of two kinds: 1. Those that are peculiar to this disease; and 2. Those that are simply dependent on the presence of the tumour occasioned by the enlarging sac. The peculiar or pathognomonic signs are those that are dependent on the communication of the sac with the artery; they consist of signs afforded by the manual and auscultatory examination of the tumour; those that are dependent on the mere size of the growth are the pressure-effects. It is of course only in external aneurisms that those signs which are ascertainable on manual examination of the tumour can usually be recognised. In internal aneurisms, in the majority of cases, the auscultatory signs and the pressure-effects afford the best indications of the presence and nature of the tumour; though, when this approaches the surface, much information can be gained by palpation.

**Symptoms of External Circumscribed Aneurism.**—The tumour is usually round or oval, distinctly circumscribed, and is situated upon and in close connection with some large artery. It is at first somewhat compressible, but afterwards becomes more and more solid as fibrine is deposited in it. The most marked sign is, perhaps, the *pulsation* that is felt in it from the very first. This is of a distensile, excentric, and expanding character, separating the hands when laid upon each side of the tumour, by a distinct impulse from within outwards. The pulsation is most forcible in an aneurism in which there is but little laminated fibrine; and as this increases in quantity the pulsation gradually loses its tense expanding character, being converted into a dead *thud*, and in some cases ceasing entirely. When pulsation is obscure, the compression of the artery below the sac will cause it to become more distinct, or it may be increased in distinctness by elevating the limb or part affected. When the artery above the sac is compressed, the flow of blood into the tumour is necessarily arrested, and a considerable quantity of its more fluid contents may be squeezed out by gentle pressure. If the hands be then laid upon each side of the tumour, and the pressure suddenly taken off the artery, the blood will be found to rush into and distend the sac by a sudden stroke, separating the hands from one another. This may be looked upon as one of the most characteristic signs of aneurism.

The *bruit* or *sound* emitted by the blood in its passage through an aneurismal sac was first noticed by Ambrose Paré. It varies much in character, being usually loud rasping or sawing—loudest and roughest in tubular aneurisms. Occasionally the bruit is double, and if so, it clearly indicates the sacculated nature of the aneurism. It is possible, however, that when great aortic regurgitation is present, the backward current of blood in the large vessels might give rise to a feeble diastolic murmur in a fusiform aneurism. In many cases it is altogether absent; this especially happens in sacculated aneurisms with small mouths, or in those that are much distended with coagula and blood. The absence of sound, therefore, in a tumour must not be taken as a proof that it is not an aneurism. The sound is usually best heard in aneurisms that are not too fully distended with blood; indeed, it is usually most distinct when the sac is partially emptied. Thus, for instance, it not unfrequently happens that, in an aneurism of the ham or thigh no bruit, or but a very faint one, is audible so long as the patient is standing; but if he lie down, and elevate the limb so as to partly empty the sac, then it may be distinctly heard. Another sign of considerable importance consists in the *diminution in* *the size* of the tumour, and the *cessation of the pulsation and bruit* on *compressing the vessel* leading to the sac, and the immediate and sudden return of these signs on removing the pressure from the artery.

Many of the symptoms that have just been described are peculiar to and their combination is characteristic of aneurism, being dependent on the communication that exists between the artery and the sac. Those that result from the pressure of the sac upon neighbouring parts are common to aneurism and to any other kind of tumour; but, though not of so special a character as those that have just been described, they are of considerable importance in determining the nature of the disease when taken in conjunction with the other symptoms.

**Symptoms of Diffused Aneurism.**—When a sacculated circumscribed aneurism becomes diffused, the sac having given way, but the blood being still bounded by the tissues of the limb, the patient experiences a sudden and acute pain in the part, and usually becomes pale, cold, and faint. On examination, it will be found that the tumour has suddenly and greatly increased in size, at the same time that it has lost its circumscribed and distinct outline. The pulsation and bruit become materially diminished in force and in distinctness, having receded as it were from the surface, and may disappear altogether. The limb may also become œdematous, or may suffer in other ways from the diffused effects of the pressure of the aneurismal swelling upon the neighbouring veins and tissues. At the same time, the circulation in it being greatly obstructed, the limb may become cold and livid, and a sensation of weight and general inutility will be experienced in it. In these circumstances the aneurismal swelling usually becomes harder, in consequence of the coagulation of the blood in the areolar tissue around the sac; by which indeed the further extension of the disease is arrested, and a fresh boundary is often formed, so as to limit the extravasated blood. If it be left to itself, the tumour will now usually rapidly increase in size, sometimes without, sometimes with much pulsation, and perhaps evidence of inflammatory action around it, so that at last it may so obstruct the circulation through the limb as to occasion gangrene; or, if it advance towards the surface, the skin covering it becomes thinned and reddened, the tumour becomes soft and semi-fluctuating, owing to the coagulum breaking down, and eventually external rupture of the sac will ensue.

In some cases it happens that, when rupture of the sac takes place, the effused blood, instead of being limited by the surrounding areolar tissue, becomes suddenly and widely extravasated into the substance of the limb. When this untoward accident happens, the shock and local disturbance are very great, and the patient is suddenly seized with a very severe lancinating and numbing pain in the part. The pain is most severe in those cases in which the rupture takes place under the deep fasciæ, by which the effused blood is tightly bound down; and it may be so severe as to occasion syncope. In other instances, faintness occurs from the sudden loss of blood out of the current of the circulation into the substance of the part, the swelling being greatest in those instances in which the blood is suddenly and largely effused into the areolar tissue. If the extravasation happen in a limb, this will become greatly swollen, hard, brawny, and cold. The superficial veins are congested, and the circulation in the lower parts of the member is soon completely arrested by the pressure of the extravasated and semi-coagulated blood upon its vessels, more particularly the large venous trunks. In consequence of this, gangrene of a moist kind usually makes its appearance, and speedily destroys the patient's life.

DIAGNOSIS.—The diagnosis of aneurism may in many cases be effected with the greatest possible ease by a student in surgery; in other instances it requires a vast amount of care, and the most experienced judgment, to come to a correct conclusion as to the nature of the tumour. This is easily done when the aneurism is superficial, recent, and circumscribed, the blood in it being fluid, and all the signs of the disease well marked. The diagnosis is often replete with difficulty when the aneurism is deeply seated, or, if external, when it is old and filled with coagula; also, if suppurative action have taken place about it, or if it have become diffused.

In effecting the diagnosis of aneurism we have, in the first place, to ascertain the existence or absence of a tumour; and, after this has been done, to ascertain whether it be aneurismal or of some other character. Both points, the latter especially, are difficult to determine in internal aneurisms; in the external, the doubt is not as to the presence of a tumour, but as to its nature. The *tumours* with which aneurisms may be confounded may conveniently be divided into two classes—those that do and those that do not pulsate.

**Every pulsating tumour is not an aneurism.** Thus there may be pulsation in various kinds of *encephaloid tumour* or *soft sarcoma,* or in *growths composed of erectile tissue.* In such cases as these, many of the signs of aneurism are present; thus the size of the tumour may be diminished by compression, and the distinct influx of blood into it may be felt on the removal of the pressure, the tumour returning to its original size with a soft swelling pulsation: there may also be a bruit, often of a loud and distinct character. But these tumours may generally be distinguished from aneurisms in not being quite so distinctly circumscribed —in being soft, spongy, and elastic, without the sensation of fluid that is met with in some forms of aneurism, or of solid coagula that occurs in others. Again, the bruit is either soft, blowing, and more prolonged, or else sharp and superficial; the pulsation, also, is not so distinct, and is more of the nature of a general swelling and heaving of the tumour than of a distinct thump. Much light is also occasionally thrown upon these affections by their being met with in situations where aneurism cannot occur, from the absence of any arteries of sufficient size to give rise to it, as, for instance, on the head of the tibia or the side of the pelvis; but if a tumour of this kind be situated upon or under a large artery in the usual site of an aneurism, then the diagnosis is certainly replete with difficulty, and cannot indeed in many cases be made. Several instances have of late years occurred, in which Surgeons of the greatest skill and experience (as Guthrie and Stanley) have ligatured arteries on the supposition that they had to do with aneurism, when in reality it was one of the pulsating tumours just mentioned that closely simulated it.

**Pulsation** may be communicated to a *tumour of a fluid character* seated upon an artery; here the diagnosis, though often difficult, is more readily made than in the last case. Attention to the history of the case, to the impossibility of diminishing the tumour by pressure, either directly upon it or on the artery leading to it, its fluctuation, and want of circumscription, will usually point out its nature. Especial attention should likewise be paid to the facts that the pulsation is a distinct heaving up and down of the tumour, and neither excentric nor distensile, and that the swelling may often be wholly or partly separated, by raising it up, from the artery lying beneath it. By attention to these points, abscesses in the axilla, under the pectorals, at the root of the neck, and in other situations where pulsation may readily be communicated to the fluid mass, can be distinguished from aneurisms; yet errors in diagnosis have happened, and will continue to do so, from the intrinsic difficulty of these cases, and from no want of skill or care on the part of the Surgeon : and those will be most charitable in their criticisms of the mistakes of others, who have most frequently had occasion to experience these difficulties in their own practice.

**Tumours that do not pulsate,** either by their own vessels or by those that lie beneath them, are not so readily confounded with aneurism as the class of affections that has just been described. Yet it must be borne in mind, that in some instances even aneurisms do not pulsate, or but very indistinctly so, having become filled with a dense and firm coagulum. The non-pulsating tumours that chiefly require attention are *glandular, scirrhous,* or *thyroid swellings,* seated over the carotid artery at the root of the neck, or in the popliteal space. If these be of a fluid character, their fluctuation, unvarying size, and the want of pulsation in them, sufficiently indicate that they are not connected with the artery, from which they may also frequently be separated, and upon which they may be distinctly moved. If solid, they are usually irregular and nodulated on the surface, and can frequently be detached by the fingers being passed underneath them and raising them from the subjacent vessel. There is much danger of mistaking a consolidated aneurism which is undergoing or has undergone spontaneous cure, and in which there is consequently no pulsation, for a solid tumour of some kind. I have known one instance in which the thigh was amputated for a very painful solid tumour of the popliteal space, which proved on dissection to be a consolidated aneurism pressing upon the posterior tibial nerve (Fig. 356).

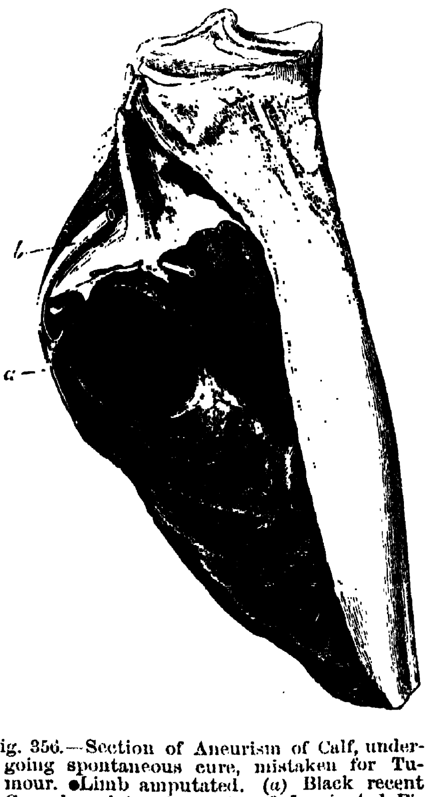


Fig. 356.—Section of Aneurism of Calf, undergoing spontaneous cure, mistaken for Tumour. Limb amputated. (*a*) Black recent Coagulum lying in centre of Laminated Fibrine. (*b*) Posterior Tibial Nerve stretched.

Aneurisms, more particularly those that are diffused, have not unfrequently been mistaken for *abscesses;* and it is no very uncommon thing for a Surgeon to be called to an aneurism which, under this supposition, has been diligently poulticed, or painted with iodine. I have twice ligatured the external iliac for aneurisms of the groin that had been mistaken for abscesses. Occasionally, the more fatal error has been committed of puncturing the tumour with the view of letting out pus, when none appeared, and, either immediately or after a lapse of a few hours, profuse arterial hæmorrhage ensued. That this accident may arise from the intrinsic difficulties of the diagnosis, is evident from the fact that it has happened to such Surgeons as Desault, Pelletan, Dupuytren, Pirogoff, and many others. I have once seen this accident occur to a Surgeon of considerable experience, who, mistaking a diffused popliteal aneurism for an abscess, opened it with a bistoury, but finding no pus, applied a poultice; alarming hæmorrhage ensued in about forty hours, and I amputated the thigh on the second day after this untoward occurrence.

The difficulty in diagnosis is especially apt to occur in those aneurisms which, having become diffused, have ceased to pulsate, have no bruit, are elastic, softened, and diffluent to the feel, and in which the skin has become reddened and inflamed by pressure from within. It is only by careful attention to the history of the case, and by skilful manipulation, that the true nature of the tumour can be made out. But an aneurism may actually become associated with an abscess in one or two ways. Thus it may suppurate, inflammation of a suppurative character taking place in the areolar tissue around it, with swelling, redness, œdema, and heat of the integumental structures, increase of size in the tumour, and probably diffuse solidification of it. If this abscess be opened or allowed to burst, dark grumous pus will escape, followed by coagula and masses of broken down decolorised fibrine, and sometimes accompanied, but more usually followed after a lapse of some hours, by a free and perhaps fatal discharge of florid blood.

Another form of combination between abscesses and aneurism consists in the opening of an artery by ulceration into the cavity of an abscess, so that the blood is projected directly into this from the opened vessel. In cases of this kind—of which the instance that occurred to Liston is a good example—we have the ordinary signs of abscess, usually of a chronic character, to which those of an aneurism are generally suddenly superadded, with great increase in the bulk of the tumour. This accident has chiefly been observed in abscess of the neck, opening up a communication with the carotid artery.

With **rheumatism** and **neuralgia** it would at first appear to be difficult to confound an aneurism, but in practice it is not so. I have known several cases in which the lancinating pains of aneurism, more especially when the tumour was internal, have been mistaken and treated for rheumatic or neuralgic affections; and I have even known the pain occasioned by the presence of a large aneurism of the thigh treated for several weeks as rheumatism. In such cases as these, it is of course obvious that a little care and proper examination will usually serve to establish the diagnosis. The aneurismal may be distinguished from the rheumatic pain by its having a twofold character—being both lancinating and intermittent, as well as continuous, aching, and burning. When this kind of pain is persistent, especially about the back, the side of the head and neck, or arm, it ought always to cause the Surgeon's attention to be directed to the condition of the neighbouring large vessels.

TERMINATIONS.—**Spontaneous Cure** of an aneurism is of very rare occurrence. The manner in which it happens has been especially and ably studied by

Hodgson, and more recently by Bellingham; and the pathology of this process is of considerable interest, from its bearing upon the cure of the disease by surgical operation. The spontaneous cure may accidentally, though very rarely, occur by inflammation of the aneurism and consequent obliteration of the artery; but most frequently it is by the gradual deposition of laminated fibrine in the interior of the sac that it is filled up completely. This process can only take place in aneurisms affecting arteries of the second or third magnitude, and never in those of the aorta; and it can only happen in sacculated aneurisms, the fusiform not admitting of it, it being necessary that the blood flowing through the sac be somewhat retarded in its passage, so as to give time for the deposit of its fibrine upon the interior of the tumour. This process, which is a very different one from the coagulation of the blood, is the increase of a natural condition always going on in the sac. In all cases of sacculated aneurism, there is a tendency to the production of a spontaneous cure, though this is rarely accomplished. The tendency to it is shown by a contraction and partial occlusion of the artery *below* the sac, and the consequent diminished force of the circulation through it, by which the deposition of fibrine is greatly increased, at the same time that the collateral vessels given off *above* the sac often enlarge to a considerable extent, and thus divert from it blood which would otherwise have passed through it. This condition of the vessel below the sac may be looked upon as the first and most important step towards the consolidation of the tumour. The process is also materially assisted by the mouth of the sac being small, and so situated that the blood cannot be directly driven into it.

For spontaneous cure to take place, it is not necessary that the whole current of blood should be suddenly arrested. If such an accident occur, the aneurismal sac becomes filled with a large dark soft clot, which soon yields, if from any cause a pulsating stream of blood be again admitted, but which under favourable circumstances may lead to a complete cure. If blood continue to circulate through the sac, deposit of laminated fibrine will take place if the impetus with which this fluid is sent into the tumour be considerably diminished. This may happen from the occurrence, in the distal portion of the artery or the mouth of the sac, of some or other of those conditions that have already been described. So, also, it has been found that, in those cases in which two aneurisms are situated upon one artery, the distal one is very apt to undergo partial or even complete consolidation, the blood losing its impetus in its passage through the first sac. Any constitutional cause or condition also, by which the impulse of the heart is lessened, and the force of the flow of blood through the sac diminished (as the occurrence of phthisis), will favour greatly the deposit of laminated fibrine and the consolidation of the tumour.

As the aneurism undergoes spontaneous cure, the pulsation in it gradually becomes more and more feeble, until it ceases entirely; the bruit proportionately lessens, the tumour becomes harder, and at last completely consolidated; at the same time, the anastomosing circulation is sometimes found to be established in some of the collateral vessels of the limb. Eventually, the solidified tumour shrinks in size, undergoing a species of drying and absorption, with ultimate conversion into a small mass of fibro-areolar tissue.

**Causes of Death from Aneurism.**—An aneurism may prove fatal in various ways. It does so when internal, most frequently by *pressure* on parts of importance in its vicinity, the patient being destroyed by the exhaustion induced by interference with their functions ; this is usually the way in which aneurisms of the aorta occasion death. Then, again, death may result by the occurrence of *syncope,* more especially if the aneurism be of large size, and situated near the root of the aorta. *Embolism* of the cerebral arteries may occur in consequence of the detachment of a clot. External aneurism most commonly proves fatal by *rupture of the sac;* this may either take place into the interior of a limb, giving rise to one or other of the diffused forms of aneurism, and terminate fatally by the induction of syncope or gangrene ; or an aneurism may kill by rupture occurring externally, on one of the surfaces of the body.

**Suppuration with sloughing** of an aneurismal sac is not of very frequent occurrence, but is especially apt to happen in those cases in which the tumour has increased rapidly, or has suddenly become diffused, with much heat and tension of neighbouring parts. It is peculiarly liable to happen in tumours of a large size that have become partly diffused, that are filled with masses of decolorised fibrine, and that are situated in places where the areolar tissue is abundant and lax, as in the axilla. The symptoms of this condition impending are swelling, tension with heat, throbbing, and redness of the parts around the tumour ; the integuments covering which pit on pressure, and are evidently deeply inflamed, at the same time that there is a good deal of fever and general constitutional irritation. As the suppuration advances, the ordinary signs of congestive abscess occur : the skin covering the tumour becomes red and livid at one part, where pointing takes place ; and if the Surgeon make an incision into it, or if the tumour burst (as assuredly it will if left to itself), a quantity of sanious pus mixed with large masses of broken down coagula and fibrine will be let out. The discharge of the contents of the aneurismal sac, disintegrated by and mixed up with the results of suppurative

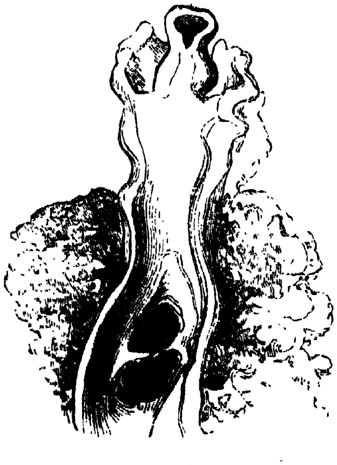


Fig. 357.—Aperture in Œsophagus produced by Pressure of an Aortic Aneurism.

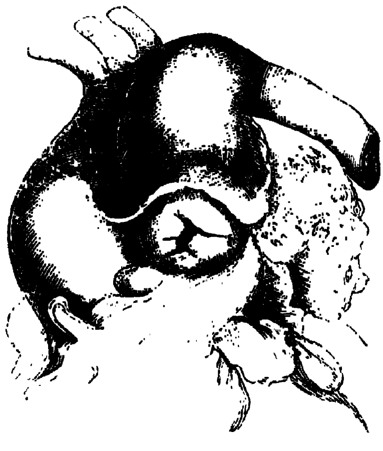


Fig. 358.—Stellate Rupture of an Aortic Aneurism into Pericardium.

action, may be followed by so profuse a gush of arterial blood that the patient is suddenly exhausted.

The rupture of an aneurism is not always immediately fatal, the aperture in the sac being plugged up by a mass of coagulum, as happened in case (Fig. 357); on the gradual detachment of the deeper portions of which the bleeding may recur in small quantities at intervals, and more or less speedily carry off the patient. On the mucous surfaces, as of the œsophagus or trachea, rupture occurs in a similar manner (Fig. 357). On the serous surfaces, as into the pleura or pericardium, the aneurism may burst by a fissure or by a stellate opening (Fig. 358) forming in the membrane. An aneurism has been known to give way and discharge blood for some weeks before it proved fatal ; and it may even happen that, after the rupture has occurred, no hæmorrhage may take place, but death may result from the pressure of the tumour. Thus, in the case of Liston, the sac of the aneurism which caused the death of that great Surgeon had actually given way, a mass of coagulum projecting from it into the trachea ; yet death resulted from the irritation induced by pressure upon the inferior laryngeal nerve, and not from hæmorrhage.

TREATMENT.—The treatment of aneurism is of two kinds—constitutional and local. In many cases, as in the various forms of internal aneurism, for instance, the constitutional treatment can alone be employed ; and in all cases of external aneurism it should be had recourse to as an important adjunct to any local measures that are adopted.

In the **Constitutional or Medical Treatment** of aneurism, the great object is to bring about the same condition as that by which the spontaneous cure of the disease is effected, and, indeed, to put the patient and the part in the most favourable state for nature to consolidate the tumour ; and, though it may not be possible in the great majority of cases to effect a cure in this way, at all events the disease may be palliated, and its progress retarded. The sacculated is, however, the only form of aneurism that can ever be cured by constitutional means ; in the fusiform variety, all that can be done is to retard the progress of the disease.

The principal objects to be held in view are, in the first place, to lessen the force of the heart's impulse, so as to diminish the excentric pressure upon the arterial coats ; and, secondly, so to modify the condition of the blood as to dispose it to the deposition of its fibrine. In carrying out these indications, it should be borne in mind that there are two opposite conditions of the system in which aneurism occurs ; in one there is a plethoric, and in the other an anæmic tendency. The plethoric and irritable state of system chiefly occurs in young subjects, in whom the progress of the disease is acute and rapid, attended by much impulse and excitability of the heart, and throbbing of the arteries generally. The other condition of the system principally occurs in elderly people, in whom there are a feeble pulse, a quiet heart, a cachectic state of health, and a tendency to anæmia ; in such a habit of body the disease makes slow progress. In these opposite conditions it is perfectly clear that the same plan of treatment cannot succeed ; and that the constitutional means must accordingly be modified according to the state in which the patient is.

In the *acute or hyperæmic state*, the plan of treatment originally introduced by Valsalva, and hence called by his name, by which plethora is removed, the irritability of the heart and the force of its action lessened, and the blood brought into a healthy condition, may be advantageously employed, in the modified manner that has been recommended and adopted by some modern Surgeons. Pellatan, and Hodgson, and Tufnell especially report very favourably of this treatment, and I have seen several instances in which it has proved decidedly beneficial. As recommended by Valsalva, this method of treatment was intended to carry out two important points: 1, by a process of gradual starvation and depletion to reduce the quantity of blood in the system, the power of the heart's action, and consequently the pressure exercised upon the walls of the aneurism; and, 2, after the patient had in this way been reduced, the plasticity of the blood was to be improved by feeding him up in a gradual and careful manner, so that the tendency to the deposit of laminated fibrine might be increased. Valsalva endeavoured to carry out the first of these objects by subjecting the patient to small and repeated bleedings, and by gradually reducing the quantity of food that was daily taken, until it was lowered to half a pound of pudding in the morning, and a quarter of a pound in the evening. In this way the patient's strength was reduced until he could scarcely be raised up in bed without fainting; the quantity of food was then gradually augmented, so that the plasticity of the blood might be restored. It is seldom that Surgeons carry out Valsalva's plan of treatment in the precise manner indicated by him; it is most commonly found to be more convenient to modify it somewhat according to the circumstances of the case, though the principles on which it is conducted are essentially the same.

In adopting any constitutional treatment in cases of aneurism, the first and most essential point to be attended to is, to keep the patient perfectly quiet in bed and free from all mental, emotional, or conversational excitement. The diet should at the same time be very carefully regulated, being gradually reduced in quantity, and being made to consist principally of farinaceous food, with but a very small quantity of meat, but little liquid, and a total absence of all stimulants. Perhaps the best regimen is that recommended by Bellingham, consisting of two ounces of bread and butter for breakfast, two ounces of bread and the same quantity of meat for dinner, and two ounces of bread for supper, with about two ounces of milk or water with each meal, or occasionally sipped in small quantities. At the same time purgatives should be administered, especially such as give rise to watery stools, and remove obstructions of the portal and renal systems; with this view a scruple of the compound jalap powder may be given twice a week. In some cases, if the heart's action be particularly strong, recourse may advantageously be had to small bleedings from time to time.

Iodide of potassium, in doses varying from five to thirty grains three times a day, has been given in several cases of intrathoracic and abdominal aneurism, especially by Chuckerbutty of Calcutta, G. W. Balfour of Edinburgh, and W. Roberts of Manchester, and its good effects lend some weight to the supposed syphilitic origin of many aneurisms. In a large proportion of the cases thus treated, the sufferings of the patients have been relieved; there has been diminution of the size of the sac, and in several instances the cure has been apparently perfect. The enforcement of the recumbent posture is, as Balfour rightly insists, of high importance as an adjuvant in this treatment. There certainly appears to be sufficient evidence to warrant a trial of the iodide in the constitutional treatment of aneurism.

By judiciously carrying out these plans of treatment and modifying them according to the circumstances of the case, consolidation of the aneurismal tumour may occasionally be produced ; or, if this be not attained, the progress of the disease will be very materially retarded.

When aneurism occurs *in old, feeble, cachectic, or anæmic persons*, a lowering plan of treatment is altogether inadmissible : here, the blood being deficient in fibrine, and the system in an irritable state from debility, the best results follow such a course as will improve the plasticity of the blood, and regulate the action of the heart. With this view, complete rest, the administration of the preparations of iron, a dry but nourishing meat diet, and the occasional employment of opiates to relieve pain and to quiet the system, will be attended by the best results. In aneurism occurring in elderly people, and amongst the poorer classes, this plan is perhaps more successful than any other.

In the **Local Treatment** of aneurism but little can be done with the view of checking its progress, except by the employment of direct surgical means. The application of ice to the surface of the tumour is said to have acted beneficially in some cases ; but it is a painful remedy, and may occasionally be attended by sloughing of the skin to which it is applied. When the pain attending the increase of the tumour is considerable, much relief may be obtained from the hypodermic injection of morphia, the application of belladonna plasters, or the use of an embrocation composed of equal parts of oil and of the strong tincture of aconite. These means comprise the only local measures that can be adopted in those cases of internal aneurism, which are beyond the reach of surgical interference.

## SURGICAL TREATMENT OF ANEURISM.

In all those cases in which it is possible to delay with safety, no surgical proceeding should be undertaken for the cure of aneurism until the patient has been subjected to proper constitutional treatment for some time ; the success of the more direct surgical means depending greatly, in the hyperæmic forms of aneurism, on the heart's impulse being lessened, and on the blood being brought into as healthy a state as possible; whilst, in the anæmic form of the disease, an increase in the plasticity of the blood is essential for the cure of the case ; for, as the occlusion and consolidation of the sac, after surgical procedure, depend on the same conditions being induced that are successful after medical treatment, the same constitutional means should be adopted in one case as in the other. Before proceeding to the employment of any direct surgical means for the cure of an external aneurism, it is necessary to ascertain that there is no internal aneurism present, and that the heart is free from disease. From want of this precaution, it has happened that patients have died on the operating table at the moment when the artery was being ligatured, or that they have expired shortly afterwards, from the disturbance of circulation consequent upon the necessary surgical procedures.

There is not a more interesting chapter in the history of Operative Surgery than that which records the changes that have taken place and the progress that has been made in the treatment of aneurism.

The older Surgeons were either afraid to meddle at all with an aneurism, and amputated the limb affected by it, or tried to restrain the progress of the disease by tight bandaging and direct pressure, or had recourse to the troublesome, difficult, and dangerous operation of laying open the sac and ligaturing the diseased artery on each side of the opening in it.

In 1785, John Hunter substituted for the barbarous and dangerous methods of treating aneurism that had hitherto been adopted, the simpler and more scientific procedure of ligaturing the artery in a healthy part of its course, above the sac, and thus directly cutting off the influx of blood into the aneurism. This operation undoubtedly constituted one of the greatest and most direct advances in Surgery that has ever been made by the single act of one man, and the "Hunterian Operation" continued for more than half a century as almost the sole method of treating this formidable disease, when situated on an artery to which the operation was applicable. It was not until 1841–42 that the Dublin Surgeons, distinguished as they ever have been by their practical skill as much as by their scientific devotion to their art, inaugurated a new era in the treatment of this disease. For they found in practice, and they demonstrated by an elaborate pathological investigation and by a surgical argument, as convincing as it was exhaustive, that the coagulation of the blood by which an aneurismal sac is occluded and the disease cured, may as readily take place when the current of blood from the artery into the sac is interrupted by the compression, as when it is arrested by the ligature of the vessel. And they established triumphantly this great fact, that wherever the artery could be reached so as to admit of compression between the sac and the heart, the scalpel was no longer needed for the cure of this formidable disease.

But the treatment of aneurism was destined to be still farther simplified, when Vanzetti showed that, by discarding all instruments and by the simple pressure of the finger on the feeding artery, a coagulum might be formed, on the production of which in the sac the cure of the aneurism essentially depends. And in addition to this, the fact was established, that in some cases adequate compression of the vessel and sac might be effected by simple flexion of the limb. Thus, then, we have had a continuous and progressive process of simplification in the treatment of aneurism, as it has been proved that instrumental compression may be substituted for the ligature, that pressure with the finger or flexion of the limb suffices for the deposition of that coagulum on which the cure of the disease depends; and, still more recently, the sphere of the applicability of compression has been greatly extended by conducting it during prolonged anæsthesia.

Another subsidiary means of treatment, but one certainly destined to play an important part in the management of some of the more intractable forms of aneurism, is electro-puncture, by which, as Ciniselli and others have recently shown, consolidation of the contents of an aneurism may be effected so as to retard the progress of the disease, if not to cure it radically.

We will now proceed to consider in detail these various methods of treatment. They are as follows: 1. Laying open the sac; 2. Ligature of the artery on the cardiac side; 3. Ligature of the artery on the distal side; 4. Compression by instruments; 5. Digital compression; 6. Flexion of the limb; 7. Acupressure; 8. Manipulation; 9. Electro-puncture; 10. Injection of the sac with coagulating fluids.

All these various methods of treatment, however they may differ in their details, have, with the exception of the first, the same great principle in view, viz.: the consolidation of the aneurismal tumour by the deposit of coagulum within it. When the process adopted is of such a nature as to lead to the slow deposit of coagulum, this will be found to be pale, firm and laminated, the *active* clot of Broca. When the deposit is rapid, it will be dark, soft and homogeneous, the *passive* clot.

LIGATURE.—The application of the ligature to the feeding artery on the cardiac side of the aneurism, was almost the only method adopted by Surgeons for the cure of the disease up to a recent date. The manner in which the ligature should be applied, and the various cautions respecting its use, have been sufficiently discussed (Vol. I., pp. 287, *et seq.*). The question as to the part of the vessel to which it should be applied in aneurism, remains for consideration; and this involves some important points.

**Situation.**—There are three situations in which the ligature may be applied: 1, *above and below the sac*, by the old operation; 2, on the *cardiac side* of the sac, by Anel's (Fig. 359) or Hunter's (Fig. 360) operation; 3, on the *distal side* of the sac, by Brasdor's or Wardrop's operation (Fig. 361).

1. The **Application of the Ligature on both sides of the Aneurismal Sac** is seldom practised at the present day, when the aneurism arises from disease of the coats of the vessel; but in those cases in which it occurs from traumatic causes, it may frequently be adopted as the best means of cure, even in aneurisms of the largest size, as has been mentioned in the Chapter on Traumatic Aneurism. The older Surgeons, however, were acquainted with this mode only of treating aneurisms. The mode of applying the ligature to both sides of the sac is as follows. After having arrested the circulation through the aneurism, by compressing the artery leading to it, either by means of a tourniquet, or, where that is not applicable, by the pressure of an assistant's fingers, the Surgeon slits up the sac, turns out the contained coagula and masses of laminated fibrine, and then, passing a probe upwards and downwards into the artery, through the mouth of the sac, ties the vessel on each side, immediately above and below the aperture. This operation, as performed by the older Surgeons on any of the larger arteries, as the popliteal, was not only so difficult

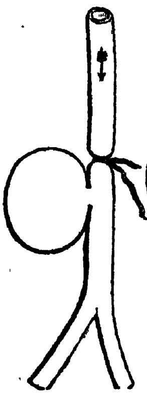


Fig. 359.—Anel's Operation.

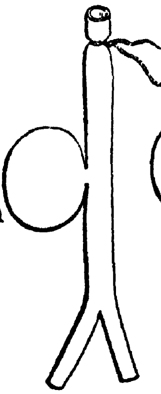


Fig. 360.—Hunter's Operation.

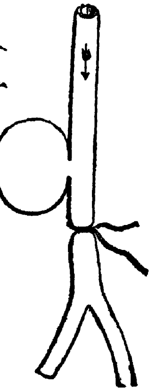


Fig. 361.—Distal Operation.

in itself that Surgeons were seldom willing to undertake it, but was so fatal in its results, being commonly attended by secondary hæmorrhage in consequence of the artery being ligatured in a diseased part, or by diffuse inflammation, suppuration, and gangrene in the deeper tissues of the limb operated upon, that recovery after its performance was considered a marvel, and most Surgeons preferred submitting the patient to amputation at once.

2. The **Ligature of the Artery on the Cardiac Side of the Aneurism**, without opening the sac, was first done by Anel, in the year 1710, in a case of brachial aneurism. This operation, though attended with the risk of wounding or inflaming the sac, which was in close proximity to the seat of ligature, constituted a considerable advance in the treatment of the disease ; inasmuch as it did not necessarily lead to the opening up of the aneurismal tumour, and to the dangers that were inseparable from that mode of procedure. As Anel, however, performed his operation as a mere matter of convenience in a particular case, and without the recognition of any new principle of treatment being involved in it, it attracted but little attention at the time, and does not appear to have been repeated by any of the Surgeons of his day.

It was reserved for John Hunter to make the great improvement in operative surgery of *ligaturing the artery at a distance from the sac*, where its coats were healthy, and where there was no danger of interference with the aneurism itself. In this way the objections to Anel's operation were avoided : for though, like Anel, Hunter tied the artery on the cardiac side only of the sac, yet he differed from him in doing so in a healthy part of its course, and at a considerable distance above the tumour, where the application of the ligature would be attended with less risk of hæmorrhage, and with no danger of opening, irritating, or inflaming the sac, which is inseparable from Anel's operation. The following are the reasons, given in Sir Everard Home's own words, that induced John Hunter to adopt the operation that is now generally known in surgery as the *Hunterian*. "Mr. Hunter proposed, in performing this operation, that the artery should be taken up at some distance from the diseased part, so as to diminish the risk of hæmorrhage, and admit of the artery being more readily secured should any such accident happen. The force of the circulation being thus taken off from the aneurismal sac, the cause of the disease would, in Mr. Hunter's opinion, be removed ; and he thought it highly probable that, if the parts were left to themselves, the sac, with the coagulated blood contained in it, might be absorbed, and the whole of the tumour removed by the action of the animal economy, which would consequently render any opening into the sac unnecessary."

Hunter's first operation was performed in December, 1785, in a case of popliteal aneurism. The femoral artery was ligatured rather below the middle of the thigh, underneath the sartorius muscle ; and from that time his method was almost exclusively employed by Surgeons in the treatment of aneurism, until the introduction of compression in 1842.

The **Effects produced upon an aneurismal tumour** by the ligature of the artery according to the Hunterian method, deserve careful attention. The immediate effect, on drawing the ligature tight, consists in a cessation of pulsation and bruit in the tumour, which at the same time subsides, becoming partially emptied of its blood. The supply of blood to the limb being in a great measure cut off, it becomes numb and cold, with a diminution of muscular power. The more remote effects consist in an increase of the activity of the collateral circulation, by which the vitality of the limb is maintained. At the same time, and, indeed, in consequence of this,. the temperature of the limb often rises, until it becomes higher than that of its fellow.

The consolidation of the aneurismal tumour begins as soon as the ligature is applied, and is usually completed in a few days, by changes taking place within it similar to those that occur in the spontaneous cure of the disease. This important change is effected by the gradual deposit of stratified and decolorised fibrine in concentric layers within the sac, and occasionally by the sudden coagulation of its contents. For the cure to be accomplished by the deposit of laminated fibrine, it is necessary that, though the direct flow of blood through the tumour be arrested by the ligature of the main trunk, some should yet be carried into it by collateral channels. This is a condition very favourable to the success of the ligature; for, if it happen that all the flow of blood through the tumour is arrested, coagulation of that which happens to be contained in it will ensue, and a soft yielding clot be formed, which is more likely to lead to unfavourable results than the firm products of slow coagulation. It is of importance to observe, that the proper consolidation of the aneurismal tumour, by the deposit of laminated fibrine, will occur even though a very considerable quantity of blood continue to flow through it. In the Museum of University College there is an exceedingly interesting preparation that illustrates this point. It is one in which Sir Charles Bell ligatured the femoral artery for popliteal aneurism. The patient died a week after the operation, from erysipelas; on examination, it was found, and is shown by the preparation, that the femoral artery was double, and that, though only one portion of the vessel had been ligatured, the tumour, which continued to be supplied by the other branch, was completely consolidated. Hence it would appear that, if one half only of the influx of blood be arrested, obliteration of the sac by deposition of laminated fibrine may be expected to occur. After the aneurismal sac has been thus occluded, it progressively diminishes in size, and is at last converted into a small fibro-cellular mass. The artery that has been ligatured becomes closed at two points—at the part deligated (Fig. 262, *a*), and where it communicates with the sac (Fig. 362, *b*). In both these situations, it will be found to be converted into fibro-areolar tissue; whilst between them there is an open space, through the medium of which the collateral circulation is freely carried on.

3. **Distal Ligature.**—In some cases in which the ligature cannot, for anatomical reasons, be applied on the proximal side of the aneurism, as in the arteries about the root of the neck, it was recommended by Brasdor that an endeavour should be made to obliterate the aneurism by ligaturing the vessel on its *distal* side. This operation, although proposed by Brasdor, was first practised by Deschamps, and has been especially commented upon by Wardrop. In principle, it resembles the Hunterian operation, the object being to arrest so much of the flow of blood through the sac that the consolidation of this may take place in the usual way, by the deposit of laminated fibrine. In the

Hunterian operation, this is effected by deposit from the lessened quantity of blood that flows through the sac; in the distal operation, it is sought to be accomplished in the same way, and the success of the operation must necessarily depend, in a great measure, upon the extent to which the flow of blood through the sac is interfered with. This operation, however, is rarely successful; for, independently of the ordinary dangers resulting from the application of the ligature to a large vessel, the sac will continue to be distended with, and to receive the direct impulse of, the blood that is driven into it, though it be not transmitted through it. The natural result of the ligature would be, therefore, to increase the tension of the sac, but, as Holmes points out, the enlargement of the collateral circulation opens, as it were, "side-sluices" to relieve this pressure, and consequently after a few hours or days the sac is usually found to be less tense than before the operation. Hence the progress of the aneurism may be arrested for a time, but it will often speedily increase again, and may perhaps eventually destroy the patient by suppuration and sloughing. Of 38 cases in which this operation has been practised on the carotid artery, in 25 instances a fatal result more or less speedily followed the operation; in the remaining 13 cases the patients survived the effects of the ligature of the artery, though in very few if any cases were they cured of the disease for which the operation was practised. This operation, however, will be considered more in detail in speaking of the particular cases in which it has been practised (*vide* Chap. xliv.).

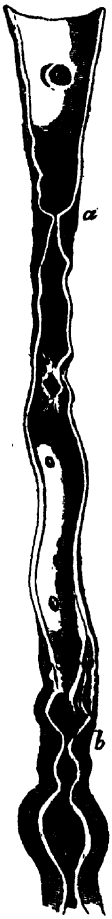


Fig. 302. — Femoral Artery ligatured for Popliteal Aneurism, obliterated at *a*, the site of the Ligature, and at *b*, where the Tumour has become consolidated and absorbed: between these points the Artery is open, and collateral branches enlarged.

**Indications and Contra-indications of Ligature.**—Ligature of an artery for aneurism, by the Hunterian method, succeeds best in those cases in which the tumour is circumscribed, of moderate size, slow in its growth, having a tendency to consolidation, and unaccompanied by much œdema of the limb. When the aneurism is undergoing spontaneous cure, no surgical interference should be employed, but the case left to nature. In this way it occasionally happens, during the preparatory treatment of the disease, that the aneurism becomes consolidated.

Before the Surgeon proceeds to cut down upon an artery with the view of tying it, he should, as far as practicable, ascertain by a careful examination of it, whether it appears to be in a healthy and sound state, at the point at which he is about to tie it. He should feel along its course to ascertain if it be smooth, easily compressible, and natural to the feel; if it be hard, incompressible, indicative of calcification; if it feel broader than natural; if a bruit be heard in it on applying the stethoscope; if, in fine, there be evidence of degeneration or dilatation of its coats, great caution should be used in attempting to ligature it. Should the deligation of a diseased artery become unavoidable, the antiseptic catgut ligature would probably be the best material for the purpose. The ends being cut short, and the wound closed over them, the chance of sloughing and of unhealthy ulceration of the vessel would be greatly lessened.

It has occasionally, perhaps more frequently than the profession knows, happened to Surgeons that they have cut down upon an artery with the intention of tying it, and found it in so diseased a state that the application of the ligature was impracticable, and that it became necessary to close the wound without completing the operation. Liston and Aston Key have both had the candour to record such cases. In one case that happened to me in which it was thought necessary to tie the superficial femoral for popliteal aneurism, I found, on cutting down on the artery, that there was a small aneurismal dilatation just below the giving off of the profunda, and a tubular dilatation of the artery below this, rendering the application of a ligature utterly impracticable. afterwards tied the external iliac, but unsuccessfully. It must be remembered that, in such cases as these, not only are the arterial coats softened and incapable of bearing the strain of the ligature, but the vein is usually adherent, and consequently liable to perforation in passing the aneurism-needle between it and the artery. And even could the act of deligation be practised, secondary hæmorrhage would undoubtedly occur at an early period in an artery that is incapable of healthy adhesive union.

All operation should be avoided when there is any serious disease of the heart, and in cases of multiple aneurism where the second tumour is situated internally; but it has happened that two aneurisms in one limb, as of the popliteal and femoral arteries, have been cured by one ligature applied to the external iliac. Two aneurisms seated in corresponding parts of opposite limbs, affecting, for instance, the two popliteal arteries, may be successfully operated upon. But, if two aneurisms be seated on different parts of the body, as the axilla and groin for instance, at the same time, the aneurismal diathesis would be indicated, and it would certainly not be expedient to operate.

In certain cases, the Hunterian operation seldom succeeds; and these, therefore, may be considered as unpromising to it. This happens in those instances in which it is necessary to apply the ligature very close to the sac, so as indeed rather to perform Anel's operation, as here there is the double danger of inflaming or wounding the sac, and of interfering with the collateral circulation of the limb. Those cases, also, in which the aneurism is very acute in its progress, increasing rapidly with forcible pulsation, having very fluid contents, and a large mouth to the sac, into which the blood is consequently driven in a full wave at each pulsation of the heart, are rarely favourable for the use of the ligature, inasmuch as stratification seldom occurs. When the aneurism is situated in the midst of loose and very yielding tissues, as in the axilla, where it readily expands to a large size, not being bound down by the surrounding parts, suppuration and sloughing of the sac are especially apt to occur after ligature. When it is diffused widely through the limb, with coldness and a tendency to incipient gangrene, the circulation of blood through the part is so much choked that the deligation of the vessel will in all probability arrest it entirely, and thus produce mortification. When arteries can be felt to be calcified, it is a question whether they can be safely ligatured, as in all probability they will be cut or broken through by the noose, and the changes necessary for their occlusion will not take place. Porter, however, recommends that the ligature should be applied in such cases, though I cannot but doubt the propriety of this advice. When inflammation has been set up in the sac, with a tendency to suppuration of the tumour, it is a debatable question whether the ligature should be applied or not. In these cases I agree with Hodgson, that the artery should be tied; for even if the sac eventually suppurate, there will be less risk to the patient if this event occur after the application of the ligature, than if it happen while the artery leading into the tumour is pervious. If suppuration have already taken place in or around the sac, the application of the ligature above the inflamed tumour on the point of bursting would be worse than useless. In such cases, the line of practice must be determined by the seat of the aneurism. If this be in the axilla, groin, or neck, it should be laid freely open, the coagula scooped out, and the artery tied above and below the mouth of the sac—a most formidable and doubtful operation, but the only one that holds out a chance of success. If the aneurism be in the ham or calf, amputation would probably be the best course to pursue.

In some instances, there is no resource left to the Surgeon but to amputate. 1. Amputation must be performed when the aneurism is associated with carious bone or a diseased joint, as when a popliteal aneurism has produced destruction of the knee. 2. If the artery be so diseased that it will not admit of the application of a ligature, and the aneurism be so situated, as in the ham, that it admits of amputation of the limb. 3. If the aneurism have attained so great a magnitude that it has already interfered seriously with the circulation through the limb, as indicated by considerable œdema, lividity, and coldness of the part, with distension of the superficial veins, it is a question whether the application of the ligature may not immediately induce gangrene, and whether the patient would not have the best chance of recovery by submitting to amputation at once; this is more particularly the case when the aneurism, whether previously large or small, has become diffused with impending gangrene, when removal of the limb must not be delayed. 4. If gangrene have actually supervened, and the patient's strength be sufficient to bear the operation, amputation should be done without delay. 5. If a diffused aneurism, whether suppurating or not, in the lower extremity, have been opened by mistake for an abscess, there is no resource left but immediate amputation.

The ligature fails from various causes in a very considerable number of the cases in which it is employed for the cure of aneurism. Thus, in 256 cases of ligature of the larger arteries for aneurism, collected and tabulated by Crisp, it would appear that the mortality amounted to about 22 per cent. And Porta finds that, among 600 cases of ligature of arteries for diseases and injuries of all kinds, the mortality amounted to 27 per cent. It must be borne in mind, that these are collections of previously reported cases, and that, if the unrecorded cases could be got at, the rate of death would, in all probability, be found to be much higher even than that above stated.

ACCIDENTS AFTER LIGATURE FOR ANEURISM.—The accidents that may follow the application of the ligature in a case of aneurism, are: 1, Secondary Hæmorrhage from the seat of ligature; 2, the Continuance or the Return of Pulsation in the Sac; 3, the occurrence of Suppuration and Sloughing of the Tumour, with or without Hæmorrhage from it; and 4, Gangrene of the Limb.

1. **Secondary Hæmorrhage** from the seat of ligature presents nothing peculiar, and has already been discussed in vol. I., p. 303.

2. The **Continuance or Return of Pulsation** in an Aneurismal Sac after the ligation of the artery leading to it, is an interesting phenomenon, and one that deserves much attention. When the Hunterian operation is successfully performed, though the pulsation in the sac be entirely arrested, a certain quantity of blood continues to be conveyed into and through it by the anastomosing channels, and it is from this that the laminated fibrine is deposited by which the consolidation of the tumour is ultimately effected. This stream of blood furnished by regurgitation, or by transmission through the smaller collateral channels, is continuous, and not pulsatory; occasionally, however, it is transmitted in sufficient quantity by some more than usually direct and open anastomosing branch, and thus gives rise to a continuance or to a return of the pulsation. It is interesting to observe that, in some of the cases in which this has happened, there has been a return of the bruit, but in the majority no sound appears to have been emitted.

The *period* of the return of the pulsation in the sac after the ligature of the artery varies greatly. In by far the majority of cases, at least two-thirds of those in which it has happened, a certain degree of thrill or of indistinct pulsation has been found in the sac shortly after the application of the ligature; at all events, within the first twenty-four hours. This may be looked upon as being rather a favourable sign than otherwise, as it is indicative of the free state of the collateral circulation, and generally soon disappears spontaneously, the sac undergoing consolidation. Next in order of frequency are those cases in which the pulsation returns in about a month or six weeks after the ligature of the artery, the collateral circulation having been fully established, and, after continuing for some length of time, gradually ceases. It more rarely happens that the pulsation returns between these two periods; that is to say, about ten days or a fortnight after the application of the ligature; though in some instances the slight vibratory thrill, scarcely amounting to a pulsation, which perhaps is perceptible a few hours after an artery has been tied, gradually strengthens at the end of a week or ten days into as distinct and forcible a beat as had been noticed before the operation. In some rare instances the pulsation has re-appeared after the lapse of some months, the aneurismal tumour having in the meanwhile undergone absorption; then indeed it may with justice be looked upon as constituting a *secondary aneurism*, and as indicating a recurrence of the complaint.

The *cause* of the continuance or of the return of the pulsation in an aneurismal sac, must be looked for in too great a freedom of the collateral circulation. Indeed, I consider it an essential requisite for the manifestation of this phenomenon, that there should be so free and direct a communication between the artery on the proximal side of the ligature, and that portion of the vessel situated between the ligature and the sac, or the sac itself, as to enable the impulse of the heart to be transmitted in a pulsatory manner into the tumour. No regurgitant blood coming upwards from that portion of the artery which is distal to the sac, however free it may be, can communicate an impulse, as it never flows *per saltum* except in the special case of a continuous circle of large anastomoses, such as are met with between the arteries within the skull, or in the palmar and plantar arches. If any of the direct collateral or feeding vessels happen to be sufficiently large at the time of the operation to transmit the wave of blood, the pulsation in the sac will be continuous, or will return almost immediately after the application of the ligature. If they be at first too small for this, they may become enlarged as part of the anastomosing circulation, and then the pulsation will return so soon as their calibre is sufficient to transmit the heart's impulse. Besides these conditions in the size and distribution of the vessels of the part, it is not improbable, as has been supposed by Porter, that certain states of the blood in some individuals may, from causes with which we are unacquainted, render it less liable to coagulate than usual, and thus dispose to a return of the pulsation in the sac, which remains filled with fluid blood.

The phenomenon under consideration has been noticed in all parts of the body after the performance of the Hunterian operation, though it occurs with different degrees of frequency after the ligature of different arteries, and is certainly of more common occurrence after operations for carotid aneurism than for any other form of the disease. Thus, of 31 cases in which the carotid artery has been tied for aneurism, I find that pulsation in the tumour continued or returned in 9 instances ; whereas of 92 cases of inguinal aneurism, in which the external iliac artery was ligatured, the pulsation recurred in 6 cases only ; and in several of these it is interesting to note that there were two aneurismal sacs in the same limb—one in the groin, the other in the ham ; and that the pulsation, though permanently arrested in the popliteal, recurred in the inguinal aneurism. In the ham and axilla, pulsation occasionally though very rarely recurs. This difference in the frequency of the recurrence of pulsation in different aneurisms, is evidently owing to the different degrees of freedom of communication that exist between the sac and the collateral branches in various forms of the disease ; thus, in a carotid aneurism, the impulse of the heart may at once be brought to bear upon the contents of the sac, through the medium of the circle of Willis. But, in the case of inguinal, femoral, or popliteal aneurism, the anastomoses, consisting rather of the inosculations of terminal branches than of open communications between large trunks, are less liable to transmit the blood in a pulsatory stream. For the same reason—the great freedom of the communication between the vessels of opposite sides—the pulsation has more frequently been found to continue uninterruptedly and distinctly, though reduced in force, after the ligature of the artery in carotid aneurisms, than in those in any other situation. The cases in which it returns after the cessation of a few hours only are perhaps as frequent in the groin and ham, as in the neck. In those instances in which the pulsation returns within the first twenty-four hours after the ligature, it usually ceases again in a few days, though it sometimes continues a week or two. When it recurs at a later period, it is apt to last somewhat longer. Compression antecedent to the ligature may so enlarge the collateral vessels as to favour a continuance or return of pulsation. I have once known the pulsation continue, though very much lessened, in a popliteal aneurism, after the ligature of the superficial femoral, in a case in which treatment by compression had unavailingly been tried for nearly three months. In another case, in which I tied the external iliac artery for popliteal aneurism, owing to the superficial femoral being too diseased to admit of a ligature, the pulsation ceased completely for a time as I was tightening the ligature, but then returned, and became very marked in a few hours. In this case compression had been unavailingly employed before the artery was tied.

The *prognosis* of these cases is on the whole favourable, but few of them having eventually proved fatal. Of 26 patients in whom pulsation recurred, I find that three died; and in all of these the fatal result was occasioned by inflammation and sloughing of the sac. In all of the three instances, the pulsation recurred within the first twenty-four hours. When it returns at a more advanced period, there is little risk to the patient, as it is usually readily amenable to proper treatment.

A *Secondary Aneurism* is of extremely rare occurrence; indeed I believe there are only two unequivocal instances of this affection upon record, both of which took place in the ham; the original tumour having disappeared entirely after operation, the secondary disease made its appearance after a lapse of six months in one case, and in the other after four years. It is of importance to distinguish between a secondary aneurism and secondary or recurrent pulsation in an aneurismal sac. The term "*secondary aneurism*" should be restricted to those cases only in which an aneurismal tumour appears in the site of a former one, which has undergone consolidation and absorption after operation. The question may be raised, whether aneurisms of this kind are in reality secondary, or whether they may not originate in the dilatation of a portion of the artery contiguous to the seat of a former disease. It is certainly not very easy to understand how an aneurismal sac that has once undergone consolidation and absorption, can again become dilated into a pulsating tumour; and I think it most probable that, although the consecutive aneurism may be found in the same surgical region as the primary one, it in reality takes its origin from a slightly higher part of the artery, where the same structural changes may have been in progress that determined the disease in the first instance at a lower point. Double aneurism thus arising is, indeed, occasionally met with in the ham as a primary disease. I have seen a case in which an aneurismal tumour was situated in the ham, and another at or immediately above the aperture in the adductor muscle: if the artery in such a case as this had been tied before the second tumour had attained any magnitude, we can easily understand how, when this became dilated, it might have been considered to be a new enlargement of the original sac, whereas, in reality, it was nothing more than a new aneurism forming in the close vicinity of the old one.

The *enlargement of an aneurismal sac without pulsation*, after the ligature of the artery leading to it, is an interesting phenomenon, and one that might cause the true nature of the tumour to be misunderstood, as it closely resembles in its slow and gradual increase the growth of a malignant tumour. It is occasioned by the distension of the sac by the dark regurgitant blood brought into it through the distal end of the vessel, without sufficient force to cause pulsation, though with sufficient pressure to occasion a gradual increase in the size of the swelling.

*Treatment of Recurrent Pulsation.*—In by far the majority of cases of secondary pulsation, this phenomenon ceases of itself in the course of a few days or weeks by the consolidation of the sac, in the same way as after ligature of the artery, from the deposition of lamellated fibrine. This tendency to consolidation of the tumour may be much assisted by means calculated to lessen the force of the impulse of the blood into the sac, such as compression of the artery above the point ligatured, rest, the elevated position, and the cautious application of cold to the part ; cold, however, must be carefully applied, lest, as the vitality of the limb is diminished, gangrene be induced. At the same time, direct pressure may be exercised upon the sac, so as to moderate the flow of blood into it ; this has in many cases succeeded in procuring consolidation of the tumour, and may most conveniently be applied by means of a compress and narrow roller. This plan is especially adapted to popliteal and inguinal aneurisms, but cannot so well be exercised upon those situated in the neck. Care must be taken that the pressure be not at first too powerful, lest gangrene result ; the object is not so much to force out the contents of the tumour, or to efface this, as simply to restrain and moderate somewhat the flow of blood into it. Should the aneurism be so situated that pressure can be exercised upon the artery above the point ligatured, this should be had recourse to either by the finger or by instrument, and will be both safer and more likely to be effectual than direct pressure. I succeeded in this way in curing a very remarkable case of recurrent pulsation in a popliteal aneurism. The patient, a man about thirty-five years of age, was admitted into University College Hospital for an aneurism, about the size of an orange, in the right ham. Treatment by compression was employed, without any effect being produced in the tumour, for three months. During this period compression was employed in all forms—by Carte's instrument, the weight, the finger, and flexion. I then ligatured the superficial femoral artery in Scarpa's triangle. The pulsation was arrested in the tumour when the ligature was tied, but returned in a slight degree in about an hour, and slowly increased, never becoming at all forcible, but being very distinct. The ligature separated on the fourteenth day. The limb was bandaged, and a pad applied over the aneurism without any effect ; and the limb was raised, but still the incessant pulsation continued. Carte's compressor was again applied to the common femoral artery, and used for about three hours in an intermittent manner, when the pulsation finally ceased.

In the event of the pulsation not disappearing under the influence of pressure, conjoined with rest, dietetic means, and the local application of cold, there are three courses open to the Surgeon : 1, To ligature the vessel higher up ; 2, to perform the old operation of opening the sac ; and, 3, to amputate, if the aneurism be situated in a limb.

With regard to ligaturing the artery at a higher point, I am not acquainted with any cases that throw much light on the probable success of such an operation. We know that the ligature of an artery high up for secondary hæmorrhage, after previous deligation of it, is a most disastrous procedure. But here the conditions are by no means identical with, or even similar to, those that accompany recurrent pulsation. In the case of secondary hæmorrhage, there has usually not been time for the full development of the collateral circulation ; whereas, in the case of recurrent pulsation, many weeks would probably have elapsed before the second operation would become necessary, so that ample time would be given for the establishment of the anastomoses ; and besides this, the very occurrence of the return of pulsation may be taken as an evidence of an unusually free anastomosing circulation. I think, therefore, that if such a case were by any possibility to occur, in which recurrent pulsation could not be checked by the application of pressure, digital or instrumental, to the artery above the point originally ligatured, aided by the other appropriate local and constitutional means that have been mentioned above, the Surgeon would adopt the proper course by ligaturing the artery higher up, *ex. gr.*, the common femoral or external iliac, if the superficial femoral had been the one previously tied. In the event of this not being thought advisable, he must choose between one or other of the two remaining operations, viz., amputation, or opening the sac. Of these measures, I should certainly prefer amputation, as offering the most favourable chance to the patient. The operation of opening the sac, turning out its contents, and ligaturing the vessel supplying it, is in any circumstances a procedure fraught with the greatest danger to the patient, and full of difficulty to the Surgeon, even when he knows in what situation to seek the feeding vessel. How much greater then must the difficulty be, when he is in uncertainty as to the point at which the artery enters the sac, and cannot know whether there be more than one arterial branch leading into it. In the event, therefore, of all other means failing, and of the pulsation in the tumour continuing, amputation is the only resource left to the Surgeon.

3. **Suppuration and Sloughing of the Sac.**—When, after the ligature of its supplying artery, an aneurism is about to suppurate, instead of diminishing in size, it increases, with heat, pain, pulsation, and some inflammatory discoloration of the skin covering it. This gradually becomes thinned, and at last gives way; the contents of the tumour, softened and broken down by the inflammatory action and the admixture of pus, are discharged through the aperture in its wall, in the form of a dark purplish-brown or plum-coloured and often fetid fluid, intermixed with masses of soft dark coagula, or of the drier laminated fibrine, which may not inaptly be compared in appearance to portions of raisins or dates. The escape of these matters, variously altered, may be accompanied or followed by the escape of florid arterial blood. This hæmorrhage, which is the great source of danger in the suppuration of an aneurismal sac, may occur in a sudden or violent gush at the time of the rupture of the tumour, by which the patient may at once be destroyed; or it may continue in small quantities, which, after ceasing, recur from time to time, thus gradually exhausting the patient. It is this occurrence of secondary hæmorrhage that constitutes the principal danger after suppuration of an aneurism, which otherwise is not a source of any very serious risk to the patient; about one-fourth only of the cases in which the sac has suppurated having had a fatal termination, and almost all those in which death resulted having proved fatal by hæmorrhage. The patients in a few remaining instances have been carried off by some special accidents, such as the pressure of the sac on the pharynx or œsophagus, or the discharge of the contents of the tumour into the pleura or bronchial tubes. Hæmorrhage is more liable to occur when suppuration takes place a few weeks after the ligature of the artery, than when a longer interval has elapsed. That hæmorrhage does not happen more frequently after suppuration of the sac is very remarkable, and must be owing

either to the sealing by adhesion or plugging by coagulum of the mouth of the aneurism, where it communicates with the interior of the artery. It is owing to this plugging also, that in many cases the fatal bleeding does not occur at the moment of rupture, but only after a lapse of some days, or even weeks, and then most usually under the influence of some incautious movement of the patient, by which the coagulum or adhesion is suddenly disturbed. Those cases are most dangerous in which pulsation has returned in the sac after the ligature of the vessel, but before the supervention of suppuration ; as in these the tumour is so freely supplied with blood that, if it burst, fatal hæmorrhage will with certainty supervene.

This accident is much more *frequent* in some situations than in others, and is more liable to occur in aneurisms of the axilla or groin, than in those of the ham or of the neck. The proximity of the ligature and the necessary interference with the sac in its application, especially in large axillary or inguinal aneurisms, is undoubtedly a frequent cause of this accident. The large size these tumours rapidly attain, in consequence of the laxity of their areolar connections, also favours it. Until recently it was believed that the occurrence of simple coagulation, instead of gradual deposit of laminated fibrine, was an important factor in the production of suppuration of the sac ; but our late experience of the treatment of aneurism by rapid compression clearly shows that the danger has been greatly exaggerated. In other cases it would appear that the fibrine, though properly deposited, acts as a foreign body, and gives rise to inflammation and suppurative action in the wall of the sac and the surrounding areolar tissue. Besides this, it has been very justly remarked by Porter, that the excessive handling and frequent examination to which an aneurismal tumour occurring in a hospital patient is usually subjected, may induce inflammatory action and give rise to suppuration.

The *period* at which suppuration of the sac may occur after the ligature varies from a few days to as many months. In the majority of instances, it would appear to take place between the third and eighth weeks ; later than this it seldom happens, though it may do so after the lapse of several months, as in a case recorded by Sir A. Cooper, in which a carotid aneurism suppurated at the eighth month.

*Treatment.*—When an aneurism is suppurating, and is on the point of giving way, it will be better to make an incision into it, so as to let out at once the broken down and semi-putrefied contents. Its cavity must then be dressed like an ordinary abscess, with a view to its filling up by granulation ; which, however, will necessarily be a slow process, in consequence of the great size and depth of the opening. During the whole of this time a tourniquet should be kept loosely applied upon the artery above the sac, so as to be tightened at any moment if bleeding take place. If hæmorrhage have already supervened, the case is attended with immediate danger. In such a case as this, the first indication is clearly to arrest the immediate flow of blood, so as to prevent the patient from dying at once. This can best be accomplished by turning out the coagula and plugging the sac with lint or compressed sponge, retained *in situ* by a firm graduated compress, and well applied roller. The hæmorrhage having thus been arrested for a time, the Surgeon should take into consideration what steps should be adopted permanently to restrain it. In some cases, indeed, though these are exceptional, the plug and compress may be sufficient to prevent a recurrence of the bleeding; but in general it will not do to trust to these means, unless the anatomical relations of the part be such as to preclude the possibility of adopting any more active measures.

Various plans suggest themselves to the Surgeon for the permanent suppression of the bleeding. The sac may be laid open, and an attempt made to ligature that portion of the artery from which the blood issues. But this can scarcely be expected to succeed, as, in the majority of the cases, the coats of the vessel being softened and pulpy, there would be little prospect of its holding a ligature, even if it were possible to expose it before the patient perished of hæmorrhage. Indeed, though this plan has been several times tried, I am not aware that by it the Surgeon has ever succeeded in arresting the bleeding from a suppurating aneurismal sac.

The application of the actual cautery to the bleeding orifice would, I think, hold out a better chance, more particularly if the blood were poured out from a collateral vessel of a small size. In this way Morrison, of Monte Video, succeeded in arresting the bleeding of an aneurism in the groin that had suppurated. Should this means, however, not suffice (and it is the only means that can be applied in many situations, as in the groin and axilla), there is no course left but, in those situations in which it can be done, either to ligature the artery higher up or to amputate. The application of a ligature nearer the centre of the circulation, even though practicable, appears to me to be of very doubtful utility; for the probability is, that the circulation through the limb, embarrassed as it must have been by the first ligature, and by the subsequent distension and suppuration of the sac, will be so much interfered with when the artery is tied a second time, that gangrene will result; or else that the collateral circulation, if sufficiently active to maintain the vitality of the limb, will also keep up the hæmorrhage from the opening in the artery communicating with the sac. In these circumstances, the only course left to the Surgeon is amputation of the limb when the aneurism is so situated that it can in this way be removed.

4. **Gangrene of the Limb.**—The general subject of gangrene of a limb, following injury and ligature of the main artery, has already been described (vol. I., p. 310); and we have at present only to consider those cases in which it occurs after the operation for aneurism.

*Causes.*—If the aneurismal sac have attained a large size with great rapidity, it may, by its *pressure* on the anastomosing vessels, or on the veins in its vicinity (Fig. 363), produce such an amount of disturbance in the circulation of the limb, preventing the influx of arterial or obstructing the efflux of venous blood, as to occasion a great liability to the occurrence of gangrene. But perhaps the principal source of danger consists in the *aneurism becoming suddenly and widely diffused*, more particularly in those cases in which the anatomical relations of the anastomosing vessels are such, as in the ham, that they may readily and uniformly become compressed by the effused blood. In these cases, the additional embarrassment induced in the circulation of the limb by the ligature of its main artery will readily induce gangrene; and hence it is that, in diffuse aneurism of the lower extremity, ligature of the artery is so commonly followed by mortification.

The *loss of blood*, either in consequence of secondary hæmorrhage, or in any other way before or after the application of the ligature, is very apt to be followed by gangrene; the more so, if it have been necessary to apply a ligature to a higher point on the trunk of the vessel than had previously been tied. This secondary ligature of a large artery in cases of aneurism has, I believe, been invariably followed by gangrene of the limb, when done in the lower extremity; the interference with the collateral circulation by the second ligature being so great, that the vitality of the part cannot be maintained.

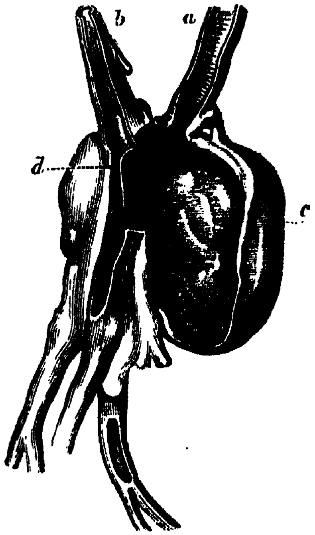


Fig. 363. — Popliteal Aneurism compressing the Vein, and thus causing Gangrene of the Limb; *a*, Artery; *b*, Vein compressed at *d*; *c*, Aneurism.

Besides these causes, the occurrence of *erysipelas*, exposure of the limb to *cold*, or to an undue degree of *heat*, or subjecting it to the *compression* of a bandage, may be attended by consequences fatal to its vitality.

The *period of supervention* of gangrene of the limb is usually from the third to the tenth day; it seldom occurs before this period, unless incipient mortification have already set in before the artery was tied. Gangrene usually follows the ligature of the external iliac at an earlier period than that of any other artery. In cases of aneurism, the gangrene is always of the dark and moist variety, owing to its being commonly dependent on pressure upon the large venous trunks by the aneurismal tumour.

*Treatment.*—The general preventive treatment of gangrene following the ligature of the artery for aneurism must be conducted on the same principles as when it arises after the ligature of arteries generally (vol. I., p. 311). But some special modifications of it are required, so far as the aneurism is concerned. When the gangrene occurs from the pressure of the sac upon the accompanying vein, it has been proposed to lay the tumour open, and to turn out its contents, thus removing the compression exercised by it. The danger of such a proceeding consists in the probability of the occurrence of hæmorrhage from the opening made into the sac, and in the risk attending suppuration set up in the sac; yet it would appear that, in two cases in which this practice has been adopted, no bad results followed. Thus, Lawrence has related a case of diffused aneurism of the popliteal artery, in which this plan was had recourse to with the best results; and Benza has recorded a case of popliteal aneurism in which the same practice was adopted in consequence of great œdema and incipient gangrene of the foot; after the extraction of a quantity of flesh-like fibrine from the sac, the patient made an excellent recovery. These cases would certainly justify the Surgeon in adopting such a course when the danger of gangrene is imminent, and dependent on the size and pressure of the tumour. Should, however, the gangrene show any disposition to extend, or should there be hæmorrhage from the sac after it has thus been laid open, the Surgeon must hold himself in readiness to amputate without delay. When gangrene has once fairly set in, there is no reasonable prospect of saving the limb; and the sooner amputation is done, the better. The limb must always be removed high up above the sac, and, if possible, not only at some distance from the parts that have mortified, but also above the part to which the serous infiltration that precedes mortification has extended. The upper extremity must generally be removed at the shoulder-joint; the lower above the middle of the thigh. In these cases there will generally be a considerable amount of hæmorrhage, and many vessels will require to be tied in the stump, in consequence of the enlargement of the collateral circulation.

Compression by Instruments.—In consequence of the dangers and difficulties attendant upon the use of the ligature, Surgeons have for many years past endeavoured to treat aneurism by compression. The employment of direct pressure on the aneurism was almost naturally suggested as a means to counteract the extension of the disease by the pressure of the blood from within, and has consequently been applied from a very early period in the treatment of the affection. This plan of treatment was first employed by Bourdelot at the close of the seventeenth century; afterwards by Genga, Heister, Guattani and others. These Surgeons made the pressure directly upon the sac; and Guattani and Flajani relate several cures that they effected in this way; but the method was so uncertain in its results, and so dangerous, from irritating and inflaming the sac, that it fell into disuse. The French Surgeons introduced a modification of the pressure plan, by laying open the sac, clearing out its contents, and applying the pressure directly over the opening into the vessel. Deschamps exposed the artery leading to the sac, and compressed this with an instrument which he termed the "presse-artère." These barbarous modes of treatment, however, were entirely set aside by the facility and comparative success of the Hunterian operation; and compression in aneurism was rarely practised by Surgeons after the great step made by John Hunter in the treatment of this disease. Yet we find that John Hunter himself, Blizard, and Freer attempted, though with but little success, to cure this disease by pressure on the artery leading to the sac. Pelletan and Dubois appear to have been the first who applied the pressure to the artery above the sac, instead of to the aneurism itself; this was in 1810. After this period, various attempts were made methodically to treat aneurisms in this way; but the merit of having introduced the practice of compression in the treatment of aneurism into modern surgery, of having given it a definite place in our art, and of having established the true principles on which it acts, incontestably belongs to the Dublin Surgeons; amongst whom the names of Hutton, Bellingham, Tufnell, and Carte deserve especial mention.

**Principle of Compression.**—In the early trials of the cure of aneurism by compressing the artery on the cardiac side of the tumour, the Surgeons who employed this method acted on an erroneous theory; and, the principle not being understood, the practice was bad. It was supposed that it was necessary, in order that a cure might take place, that the *whole* flow of blood through the artery should be entirely arrested; that inflammation of the vessel at the point compressed should be set up; and that the consolidation of the aneurism depended upon the obstruction of the vessel consequent upon this inflammation. This led to the employment of such violent and forcible compression, with the view of exciting inflammation in the artery, that the patient could seldom bear it for a sufficient length of time to effect a cure; sloughing of the skin commonly resulting from the severity of the pressure to which it was subjected. To the Dublin Surgeons belongs the very great merit not only of having pointed out the error of this doctrine, but of having distinctly laid down as the principle of the practice, that, in the majority of cases, the aneurism was cured, when the artery leading to it was compressed, in precisely the same way as when a spontaneous cure takes place, or when the Hunterian operation is performed—viz., by the deposit of stratified fibrine in the sac, and by the consequent consolidation of this (Fig. 364), aided by the contraction of the walls of the sac; and that, as in the case of ligature of the vessel, it was not necessary that the whole of the circulation through the artery should be entirely and permanently arrested, but merely that it should be lessened in quantity and force to such an extent as to be compatible with the deposition of laminated fibrine in the sac; and it was clearly shown by examination after death that, if the pressure were properly conducted, the artery was in no way injured or occluded at the part compressed. The recognition of the true principles on which compression of the artery leading to the sac cures the aneurism, has led to important results; for as the severe pressure that was formerly considered necessary is now known not only to be unnecessary, but often to be absolutely injurious, no amount of compression is exercised beyond what is requisite to restrain and moderate the flow of blood into the sac; no attempt being made to compress the artery so severely as to lead to its obliteration by inflammation.

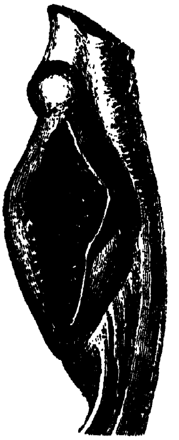


Fig. 364. Sac of Aneurism cured by Compression: Deposit of Laminated Fibrine.

But, although, where the pressure is moderate or the anastomosing circulation free, the consolidation of the contents of the sac takes place in the way that has just been described, it would be an error to suppose that this is the process by which the aneurism becomes cured in all cases in which recourse is had to compression. There can be no doubt that in some cases, where consolidation has taken place in a few hours after the employment of pressure, coagulation of the contents of the sac has suddenly occurred; and this sudden coagulation, which at one time was dreaded by Surgeons, has been found by increased experience to be in the highest degree advantageous, as leading to a more rapid and equally certain cure of the aneurism.

In the tubular form of aneurism, which is far less frequent than the sacculated in the extremities, the cure appears to take place rather by the gradual contraction of the partially emptied sac than either by the slow deposit of laminated fibrine, or by the rapid and almost sudden coagulation of its contents. The sac gradually shrinks, and shreds of fibrine only are found adherent to its sides. But although I believe that the condition of the aneurism, whether sacculated or tubular, has a considerable influence upon the mode in which the compression acts in effecting a cure, and also upon the time that is occupied in the treatment, this being much shorter in the sacculated than in the tubular form of the disease; yet there can be no doubt that this is also materially influenced by two other circumstances—viz., the condition of the blood within the sac, and the completeness of the compression.

When the sac is filled with fluid blood, and the compression is not uninterruptedly complete, the sac appears to empty itself to a considerable extent, and eventually to consolidate by the deposit of laminated fibrine. But, if the sac already contain some solidified layers, and the compression be continuous and complete, the coagulation of the remaining fluid part of its blood is apt to take place rather suddenly. But in all cases the contraction of the sac, consequent upon the arrest or restraint of the current of blood into it, is an important element in the cure. Illustrative of this mode of cure, there is a preparation in the Museum of University College (Fig. 365).

From all this, then, it would appear that the consolidation and cure of an aneurism by compression may and does take place in three different ways: 1, by the slow deposit of laminated fibrine; 2, by rapid coagulation of the contents of the sac; 3, by contraction of the sac. The particular mode of cure will depend upon the completeness of the compression and the more or less perfect arrest of the blood in the sac, the plasticity of that blood, and the shape of the aneurism.

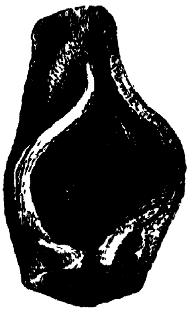


Fig. 365.—Sac of Tubular Aneurism cured by Compression: Contraction of Sac, and irregular Deposit of Fibrine.

*Circumstances influencing Success.*—The success of the treatment by compression depends greatly upon a scrupulous attention to a number of minor circumstances, which, though each be trifling in itself, become of importance when taken as a whole. During the whole of the treatment, also, the patient's general health should be attended to in accordance with those dietetic and medical principles that have already been laid down in speaking of the constitutional treatment of the disease, having for their object the increase of the fibrination of the blood. The irritability of the heart and arteries must also be subdued, and the irritation of the system lessened, by the use of opiates or of chloral; and the patient should be put into a comfortable bed, with firm and well-secured pillows and mattresses, so that his position may not be changed. As it is principally in aneurism of the lower extremity that compression can be employed, we shall proceed to describe the method of its application here.

**Application of the Compressor.**—The thigh should, if necessary, be shaved, so as to remove all hair. The skin should then be powdered, and the limb bandaged with a soft roller; a pad being laid on the tumour. Pillows must then be comfortably arranged under it, the knee being semiflexed. Much of the success of the treatment will depend upon the kind of instrument used. The ordinary horse-shoe, or Signorini's tourniquet, was the one first employed, and this will, in many cases, answer the purpose perfectly well; but, as it is somewhat difficult to regulate the pressure with this instrument, and as it is not unfrequently exercised too powerfully, it has generally given place at the present day to the very ingenious apparatus of Carte, which, as it substitutes an elastic force derived from vulcanised India-rubber bands for the unyielding pressure of the screw, accommodates itself better to the limb, and is less likely to produce injurious compression. This instrument, as well as the other contrivances which have at various times been invented for the treatment of aneurism by compression, are described by Bellingham and Tufnell, in their works on this subject, to which I must refer for a fuller account than I can here give.

In applying the compressor, especial care must be taken that it is well padded in every part, so as not to gall the skin. In some of the early cases in which I saw compression employed in London by means of the horse-shoe tourniquet, much inconvenience resulted from want of attention to this particular. The tendency to fretting of the skin is much lessened by powdering the limb ; and the removal of the hairs by shaving diminishes materially the irritation produced by the instrument. In order to keep up continuous pressure, and at the same time to prevent any one part of the skin from being injuriously galled, it is of very great consequence that two instruments should be used at the same time, so that when one is screwed down the other may be loose ; these instruments need not be placed closely together. If the aneurism be in the ham, it will be sufficient for one (Fig. 367) to be applied to the groin, whilst the other (Fig. 366) is put upon the middle of the thigh (Fig. 368). In using the instrument, the great point, as Tufnell most properly remarks, is to control the circulation with the minimum of pressure. In order to do this, the first instrument should be screwed down so that all pulsation ceases in the tumour, but still not so tightly as completely to arrest all the flow of blood through it. As the pressure exercised by this becomes painful, the second one must be screwed tight, and then the first compressor may be slackened. In this way an alternation of pressure can be kept up without much pain or inconvenience. If possible, the patient should be taught how to manage the instrument himself, and will often find occupation and amusement in doing so.

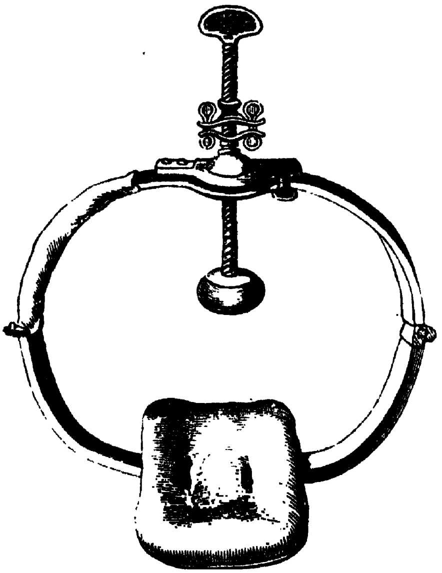


Fig. 366.—Compressor for the Middle of the Thigh.

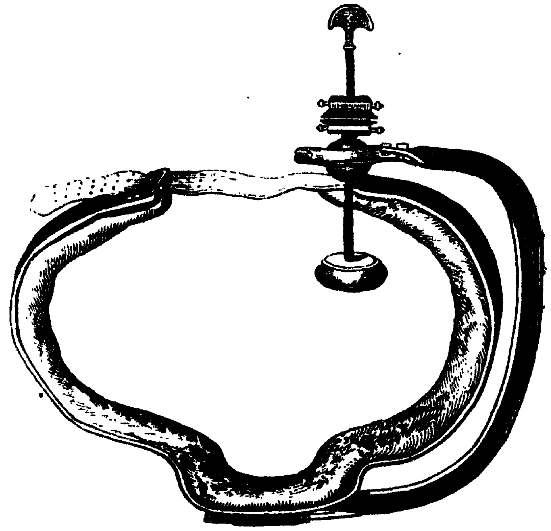


Fig. 367.—Compressor for the Groin.

If, however, it excite much pain or irritation, as it does in some subjects, it may be necessary to give opiates or chloral hydrate. The pressure should, if possible, be continued during sleep; but if it prevent the patient from taking his natural rest, the suggestion made by Tufnell, of unscrewing the instrument slightly, and, when the patient is asleep, gently tightening it again without awakening him, may advantageously be adopted; it is indeed surprising how very little unscrewing will relieve the pain of the compression. A large cradle should be placed over the patient's body, so that the weight of the bed-clothes may be taken off the apparatus, and that the patient may manage it without risk of disturbance. Should there still be much uneasiness, the instrument might be taken off for a few hours, and compression kept up in an intermittent manner. Even in such circumstances as these, consolidation of the sac may ensue.

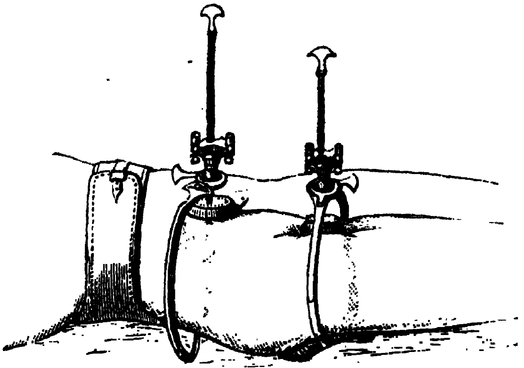


Fig. 368.—Two Compressors applied for Femoro-popliteal Aneurism.

In some cases, where, from the situation of the aneurism, deep and severe pressure is required to control the circulation, the pain becomes so unendurable that the patient cannot submit to the treatment sufficiently long for a good effect to be produced. In such cases opium or chloral hydrate may be given with advantage, so as to enable the patient to bear the pressure. But in some instances more complete narcotism is necessary for him to endure it. In these circumstances, chloroform becomes a most useful adjunct; and by maintaining the anæsthesia for several hours, the amount and duration of pressure requisite to effect a rapid cure may be maintained. In this way W. Murray of Newcastle-on-Tyne—to whom is due the merit of employing prolonged anæsthesia as an adjunct to compression—cured an aneurism of the abdominal aorta by keeping up pressure on that vessel for five hours under chloroform. Heath of the same town cured an aneurism of the external iliac by compressing the abdominal aorta for seven hours under chloroform; Mapother of Dublin treated an ilio-femoral aneurism successfully by compressing the common iliac artery for four and a half hours; and Lawson treated an inguinal aneurism successfully by pressure on the abdominal aorta for four hours. In two cases of popliteal aneurism, I kept up completely obstructing

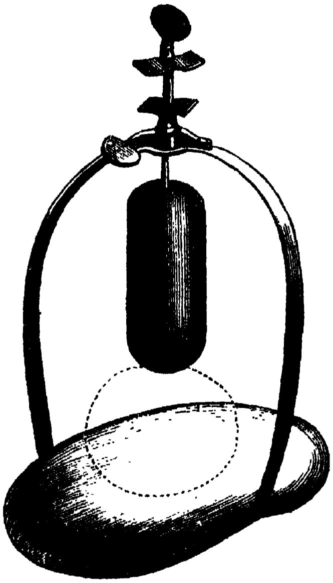


Fig. 369.—P. H. Watson's Weight Compressor. The circular dotted line shows the position of the limb.

pressure on the common femoral artery, under chloroform, for twelve hours. By these means the only serious objection to the employment of pressure, and almost the only cause of its failure, may be prevented; and it is clear that, under chloroform, pressure may be applied to arteries, such as the subclavian and carotid, on which it could not otherwise be used. The employment of a *weight* may sometimes be advantageously substituted for the clamp, and often occasions less distress to the patient. For this purpose the apparatus (Figs. 369) will be found very useful.

A very simple compressor is Tufnell's compressor, represented in Figs. 370, 371. It consists of little more than a truss-spring, with a pad to compress the artery, and straps to fix it in its place, and increase, by being tightened, the force of the compression.

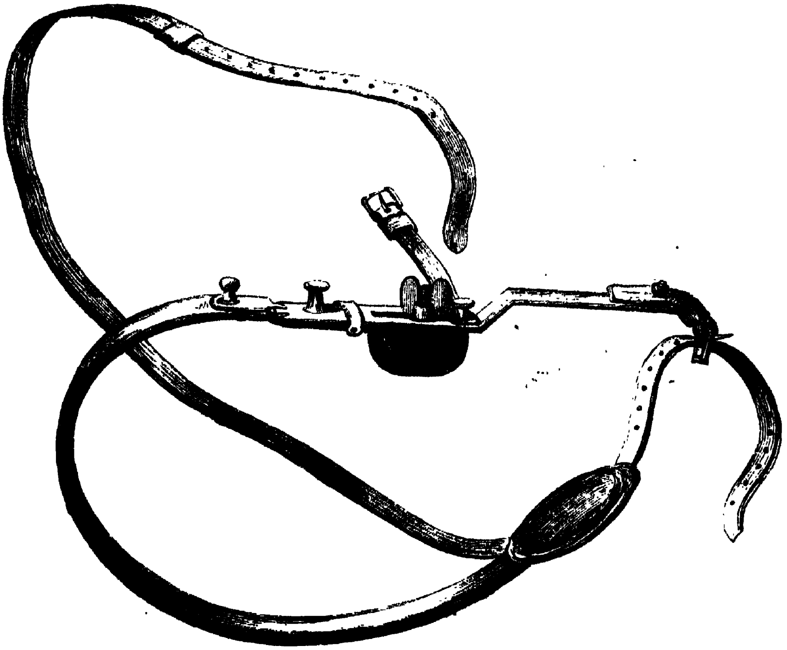


Fig. 370.—Tufnell's Compressor.

The **Effects upon the tumour** vary considerably. In some cases it rapidly and suddenly solidifies; more commonly, however, this is a gradual process, the aneurism becoming more painful and solid, with less pulsation and bruit. As the solidification takes place, there is usually some restlessness, a feeling of general uneasiness, and of constitutional disturbance, which is best quieted by opiates. As the pressure is continued, and the tumour begins to harden, the anastomosing vessels enlarge, with a good deal of burning pain in the limb generally, and arterial pulsations in situations where usually none are felt. The abnormal pulsation, in these cases, is always found to occur in much the same situations, the same vessels appearing to undergo dilatation. Thus Tufnell has made a remark, which I have had more than one opportunity of verifying, that, in the treatment of popliteal aneurism by compression, three arteries will be found to be enlarged, one of which passes over the centre of the tumour, another over the head of the fibula, and the third along the inner edge of the patella; he also states that the severe burning pain which is felt in these cases is owing to the artery accompanying the communicans peronei nerve being enlarged. After complete solidification of the tumour has taken place, the compression ought to be continued for at least forty-eight hours, so as to secure against the occurrence of a relapse.

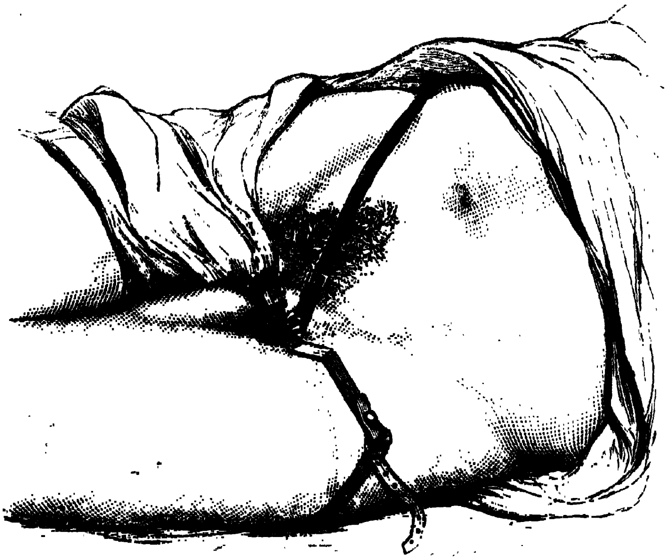


Fig. 371.—Tufnell's Compressor applied.

The **Duration of the Treatment** varies very greatly. In some cases, as above stated, the tumour has become solidified in a few hours or in two or three days. In other instances, the treatment has required to be protracted for more than three months before a cure has resulted. Of 26 cases of femoral or popliteal aneurism cured by compression in the London hospitals, the average time, according to Hutchinson, was nineteen days. Much of course will depend, in this respect, on the constitution of the patient, and on the condition of the tumour; those circumstances which are most favourable to the spontaneous cure of the aneurism will also influence the rapidity of the cure by compression. There are, undoubtedly, certain conditions of the blood in which it is little disposed to coagulate, and in these cases the duration of the treatment will necessarily be prolonged. So, also, when the aneurism is tubular, we must expect that the blood which passes freely through it in the direct current of the circulation will be slower in undergoing those changes that lead to its consolidation than when the disease is sacculated, and thus contains a residuum of blood that is not so directly influenced by the current through the sac. In the early days of the compression treatment, there was an indisposition on the part of Surgeons to apply it very effectually and firmly, and a longer time was expended over it than is now generally the case ; and the example set by Murray, with regard to abdominal aneurism, has been followed with success in respect to the femoral, popliteal, and other forms of the disease, the compressor being screwed down tight on the artery so as completely to arrest for the time all circulation through the sac, the patient kept under chloroform, and the cure effected in a few hours.

**Applicability.**—Of the great value of compression in the treatment of aneurism, there can be no doubt ; more especially when the tumour is situated in the arteries of the lower extremity below the middle of the thigh. In aneurisms occurring in the vicinity of the trunk, as in the iliac, the carotid, subclavian, and axillary arteries, it is generally not so applicable ; although, as we have already seen, aneurisms in the groin have been cured by compression of the abdominal aorta, or of the iliac artery. Spontaneous aneurism is extremely rare in the upper extremity ; and, as the traumatic forms of the disease which occur here generally require that the sac should be laid open, it is seldom found necessary to have recourse to it in this part of the body, though it may be and has been successfully applied to the brachial artery.

The great question with regard to compression appears, after all, to be whether it possesses any special advantages over the ligature, in the treatment of those aneurisms in which its employment is practicable. The principal objections that have been urged against compression are, that its employment is more painful and tedious than the use of the ligature ; and that those cases that are unpromising to the ligature, or that require amputation rather than deligation of the artery, are equally unfavourable to compression, and cannot be saved by its employment.

To these objections it may with justice be answered, that the pain attendant on the employment of compression depends very greatly upon the skill and care with which the apparatus is applied and managed throughout, as well as upon the kind of instrument used, being certainly much diminished when Carte's elastic compressor is employed ; and that, as has already been shown, the pain may be overcome by the use of anæsthetics. With regard to the relative tediousness of the treatment under the two plans, it would appear that in reality there is but little difference ; for although some cases, in which compression is used, are prolonged over a considerable space of time, yet they do not occupy more than is often consumed when accidents of various kinds follow the use of the ligature ; and it not unfrequently happens in compression, but can never occur after the employment of the ligature, that the patient is cured of his disease in a few hours or days. Taking, however, the averages, we find that in the Dublin cases the treatment lasted twenty-five days, and in the London cases but nineteen, and this is not very different from what happens with the ligature ; for, of 54 cases recorded by Crisp, in which the femoral artery was tied, the average time for the separation of the ligature was eighteen days, and if to this a week more be added for the closure of the wound, and for the treatment of the various accidents often accompanying and following ligature, we should probably be within the mark, and yet only bring the duration of the treatment of the two methods to the same level.

After all, Surgeons will eventually be guided in their estimate of the value of these two plans, not so much by the question of submitting their patients to a slightly more painful or tedious treatment, as by the comparative risk of life attendant upon one or other method. Upon this point the statistics have yet to be made; partly because cases of the treatment of aneurism by compression have not yet been sufficiently numerous, and partly because the unsuccessful cases of ligature have not been so commonly published as the successful ones. If, however, we compare the 32 cases of femoral and popliteal aneurism treated in Dublin up to February, 1851, as given by Bellingham (*Med.-Chirurg. Transactions*, vol. 34), with the results of 188 cases of femoral and popliteal aneurism recorded by Norris, in which the artery was ligatured, we shall find that of the 32 compression-cases 26 were cured; in 1 the ligature was applied after pressure had failed; in 2, amputation was performed; in 1, death occurred from erysipelas; in 1 from chest-disease; and in 1 case the pressure was discontinued. Thus it would appear that 6 out of the 32 failed, being in the proportion of 1 to 5·3 cases, and 2 died, being in the ratio of 1 to 16. Of the 188 cases in which the artery was ligatured, 142 were cured, 46 died, 6 were amputated, in 10 the sac suppurated, and in 2 gangrene of the foot occurred. Thus the deaths after ligature were in the proportion of 1 to 4, and the failures or serious accidents in that of 1 to 3, showing clearly a very considerable preponderance in favour of the treatment by compression. Besides this, in many patients who recovered after the ligature, various accidents, such as gangrene, erysipelas, secondary hæmorrhage, &c., resulted as the direct consequences of the treatment; and these do not happen when pressure is employed.

The perfect safety of the treatment by compression has been fully confirmed by the statistics collected by Holmes, and published in his lectures on the Surgical Treatment of Aneurism; but the proportion of success is not so great as in Bellingham's cases. Of 124 cases of compression for popliteal aneurism collected from the records of British hospitals for a period of 10 years, 66 succeeded and 58 failed. None died directly from the consequences of the operation. Of the 58 failures, 44 underwent ligature of the femoral, in 8 amputation was performed, one died of pleurisy, and the subsequent history of the remainder was uncertain. The failures were, therefore, 1 in 2·1. On the other hand, of 77 cases, in which the femoral was tied directly, 11 died, or 1 in 7. In 1 gangrene occurred, but the patient recovered, and in 1 secondary hæmorrhage was successfully treated. The 11 deaths were caused as follows: pyæmia 3; wound of vein and phlebitis 2; secondary hæmorrhage 2; gangrene 1; small pox and disease of the kidneys 1 each, and 1 was uncertain.

If compression fail, ligature may often be advantageously applied; in some cases with a better prospect of success than if compression had not previously been tried, that treatment having caused the collateral circulation to enlarge, and thus lessened the tendency to gangrene. If, however, we take the general average of those cases that have been submitted to ligature after the failure of compression, we shall find that the result is not so satisfactory as when the ligature has been employed as the primary method of treatment. Thus I find that, out of 40 cases in which the ligature was employed after compression had failed, there were 16 deaths. This is probably not so much due to the previous employment of compression, as to the same causes interfering with the consolidation of the tumour after the ligature that had prevented the success of the compression-treatment. With regard to the facility of ligaturing an artery such as the femoral, after compression has been tried and failed, it must be admitted that the difficulties are increased. The sheath of the vessels is apt to become thickened, infiltrated, and the artery and vein perhaps less easily separable than when pressure has not previously been employed. In fact, it must be said, that in such cases the Surgeon has not to do with a virgin artery.

It should also not be forgotten that in some cases, as when aneurism is complicated with heart-disease, or occurs in a very broken and unhealthy constitution, in which the operation necessary for ligature would scarcely or not at all be admissible, compression may be safely employed.

After carefully considering the relative merits of the two plans of treatment, I think we may conclude that, though in some few cases neither ligature nor compression can be adopted, and amputation is the sole resource, yet in others compression can be employed when it would not be safe to have recourse to the use of the ligature; and that, in all ordinary cases of femoral and popliteal aneurism especially, compression should be preferred to the ligature, inasmuch as it is not a more tedious, and an infinitely safer method of cure. At the same time, it must not be forgotten that its success depends very greatly on the continuous care bestowed upon the case during the progress of the treatment.

Digital Compression.—Shortly after the introduction of the treatment of aneurism by instrumental compression, the fingers were used as an adjunct to the mechanical means in use. Thus Greatrex, in 1845, directed a patient to keep up compression by means of the fingers, where the tourniquet had been used, and required to be loosened. In the following year (1846) Vanzetti, then Professor of Surgery at Charkoff, tried, but unsuccessfully, to cure a large popliteal aneurism by compression of the femoral with the fingers only, continued for two days. It was not until seven years later, when Professor at Padua, that Vanzetti had an opportunity of putting this method successfully into practice, and to establish it as a distinct means of curing aneurisms. But although this merit is undoubtedly due to Vanzetti, we must credit Knight of Newhaven (U. S. A.) with the first successful case—he having, in 1848, cured a very large popliteal aneurism by digital compression, maintained for forty hours.

In this plan of treating aneurisms, no apparatus of any kind is used; but the circulation through the artery leading to the tumour is controlled by the pressure of the finger. In order to carry it out efficiently, there must be relays of assistants, each one of whom compresses the vessel for about ten minutes at a time. The pressure should be applied in the way that is represented in Fig. 5, Vol. I., p. 35. The fatigue may be very materially lessened by placing a six or eight lb. weight on the compressing finger. With such aid each assistant may readily keep up the pressure for half an hour at a time. So soon as his fingers become fatigued, but before he relaxes the pressure, another assistant compresses the vessel; and thus the circulation through it may be uninterruptedly controlled. In this way aneurisms of the popliteal artery, in the orbit, at the bend of the arm, and in the groin, have been successfully treated—the tumour having in some instances become consolidated in a few hours. The effect of digital compression and the rapidity of cure, would be increased by the application of direct pressure to the tumour, or by manipulation and by the previous employment of proper constitutional means. It might be very advantageously conjoined with the treatment by flexion; but its great advantage seems to be, that it is applicable to arteries, as at the root of the neck, to which it might be difficult to apply any kind of compressor, or when the Surgeon is so placed as not to be able to obtain such an apparatus.

**Esmarch's bloodless method** has been successfully employed in the treatment of a popliteal aneurism by Dr. Walter Reid. The bandage and tubing were applied in the usual way, up to and on the middle of the thigh. The bandage was then taken off, and the circulation arrested for fifty minutes. The patient complaining of pain, a Carte's compressor was substituted for the elastic tubing, when it was found that all pulsation had ceased in the sac. The compressor, however, was used as a precautionary measure for a day or two longer, lest the newly formed clot should be broken down, and washed away before it had had time to toughen, and the sac to contract. The cure was complete and permanent. This means is applicable to many external aneurisms, and evidently deserves a further trial. It acts, like rapid compression, by the coagulation of the aneurismal blood, not the lamination of its fibrine.

FLEXION.—The treatment of aneurism by the flexion of the contiguous joint is a method that is scarcely applicable to any other form of the disease than the popliteal. The history of this plan of treating aneurisms is interesting, as an illustration of the gradual steps by which Surgery usually arrives at its ultimate results. It had been long known to Surgeons that the pulse at the wrist might be arrested by the forcible flexion of the forearm on the arm; and Malgaigne and Richet had recommended this means for the arrest of hæmorrhage from the brachial artery and the arteries of the forearm when wounded. Fleury—a distinguished French naval Surgeon—having succeeded in curing a wound of the brachial artery by forced flexion of the elbow, aided by direct compression, and one of the radial by flexion of the wrist, published in 1846 a memoir, in which he stated, as a conclusion from his observations, that any aneurism of the forearm or leg might be treated by means of flexion of the limb in which it was situated. To A. Thierry is due the honour of having been the first to cure a traumatic aneurism of the bend of the arm by flexion of the limb. This was in 1852.—(*Richet, Dict. de Méd. et de Chirurgie*, Vol. II., p. 338.) In 1857, Mannoir of Geneva applied the flexion-treatment to a large aneurism of the ham. Forced flexion could not be borne on account of the pain it occasioned, and the patient was therefore allowed to walk on crutches with the leg bent, and supported in a kind of stirrup attached to the opposite shoulder. In less than three weeks the cure was effected, which Mannoir found a year afterwards to be permanent. In the following year, 1858, Mr. Hart applied this method of treatment successfully in a case of popliteal aneurism, and to him is due the merit of having been the first to introduce it into this country.

Flexion is necessarily only applicable to arteries situated at the bend of joints, as the elbow or ham, in which the circulation can be directly controlled by bending the limb, or in traumatic aneurisms in the limbs below these joints, in which the flow of blood through the feeding artery can be stopped in the same way. Its application is therefore somewhat limited, and its use is still further restricted by the pain and insupportable annoyance occasioned in many cases by forced flexion of the limb, necessitating, as in Mannoir's case, a relaxation of the method, which, however, was still effective in curing the aneurism.

Nothing can be simpler than the details of this plan. It consists, in the lower limb, in bandaging the limb and then gradually flexing the leg upon the thigh, so that the heel is brought up towards the buttock, where it is retained by a strap or bandage. The patient is at the same time confined to bed, and put under proper constitutional treatment. By this means, the popliteal artery being bent at an acute angle, the circulation through it is nearly, if not completely arrested; and the obstacle to the flow of blood is still further increased by the compression of the tumour between the posterior flat surface of the femur and the upper part of the calf. In this way the aneurism is most favourably situated for the consolidation of its contents, which, in the recorded cases, has often taken place at an early period.

The principle on which the cure is effected in these cases appears to be, that by flexion the artery leading to and from the sac, and the aneurism itself, are so compressed that retardation of the circulation ensues, and deposition of laminated fibrine takes place in the usual way.

The compression by flexion, like every other method of treating aneurisms, occasionally fails. It is most likely to be attended by success in those cases in which the aneurism is small, situated low in the popliteal space, and in a young or middle-aged subject, who can bear the continued flexion without much inconvenience.

When flexion is not sufficient of itself to cure an aneurism, it may very advantageously be had recourse to in addition to other methods of treatment, more especially with that by digital compression.

The statistics of the treatment by flexion require to be carried down to the present time. Those published by Fischer in 1870 comprised 57 cases. Of these 28 were cured—20 being by compression alone; and in 29 the method failed.

COMPRESSION BY ACUPRESSURE of the main artery leading to the sac is a means that, I think, might in certain cases be temporarily employed with advantage, and the consolidation of the aneurism thus obtained in cases where compression by the ordinary methods, digital or instrumental, is not practicable. With this view a long and strong curved needle, such as the stilet of a rectum-trochar, might be dipped deeply under the artery and vein, *e.g.*, the common femoral, and the artery compressed against this by means of a cork and twisted suture for several hours—the vein being left free. The patient might be kept under chloroform, if necessary. When consolidation of the contents of the sac was obtained, the compressing means might be removed. Such a method of treatment might possibly be advantageously combined in certain extreme and exceptional cases with the injection of the sac with the perchloride of iron, or the use of electro-puncture.

The various methods of employing compression, viz., by clamps, by weight, by flexion, and by the finger, may often be advantageously combined in the same case. When the patient tires of one, another may be substituted for it; and thus the good effects continuously kept up with less fatigue and irritation than would otherwise be experienced. So also various modifications of these different methods may be practised to suit the requirements of any particular case. But for these no special directions can be given; the ingenuity of the Surgeon must supply the want in each case.

MANIPULATION.—Sir W. Fergusson has proposed to treat some aneurisms by a procedure which he terms *manipulation*. This consists in squeezing the aneurismal tumour in such a way as to detach a portion of the coagulum within it, which, being carried on with the current of blood into the distal end of the artery, obstructs this; and thus, by impeding the circulation through the sac, may lead to the gradual consolidation of the tumour; and it has also been suggested by Oliver Pemberton that the alteration of the relations of the laminated fibrine in the cavity of the aneurism may bring about a further deposition of fibrine on the displaced laminæ. This procedure has as yet been employed to too limited an extent to enable us to form an estimate of its value, and can scarcely be considered, nor is it intended to be, of very general application. To aneurisms, however, that are not amenable to ordinary surgical treatment, and that must necessarily prove fatal if left, as those situated at the root of the neck, more particularly of the subclavian artery, it might possibly be advantageously applied. It is scarcely necessary, however, to point out the obvious danger of rupture of the sac, or of the diffusion of the aneurism from the weakening of its walls by the separation of the coagulum, to make Surgeons adopt due caution in carrying out this method of treatment. There is another danger also especially attendant on this procedure, when applied to aneurisms about the neck; viz., that the detached coagulum may be carried by the circulation into the cerebral arteries, and by obstructing them occasion the same kind of cerebral disturbance that occurs when these vessels become occluded by fibrinous plugs—embola. That this danger is a real and a great one, is evident from the fact that, in several cases in which manipulation of subclavian and carotid aneurisms has been tried, the patient has been suddenly seized with syncope and hemiplegia. Teale has successfully conjoined manipulation with compression in a case of popliteal aneurism, in which the pressure on the artery was slow in consolidating the tumour; the detachment of a portion of the coagulum almost at once led to the consolidation of the tumour. Somewhat analogous to this method is one recommended in 1842 by Blake, who proposed, by the introduction of a cataract-needle into the sac, to detach some of the laminated fibrine, which might then be washed against, and occlude the aperture of exit.

GALVANO-PUNCTURE.—The attempt to procure the consolidation of an aneurismal sac by the employment of electricity or galvanism is of comparatively recent date. It appears to have been first practised by B. Phillips, about the year 1832. Little attention, however, was given to the mode of treatment until a few years back, when it was revived by some of the French and Italian Surgeons, especially Pétrequin, Burci, and Ciniselli. The principle on which this operation is conducted consists in endeavouring to produce coagulation in the aneurismal sac by decomposing the blood contained in it by means of the galvanic current. When two needles connected with the poles of a galvanic battery are introduced into a mass of fluid blood, a firm solid coagulum is rapidly formed round that connected with the positive pole, while at the same time a large, soft, spongy clot mixed with bubbles of gas is seen at the negative needle, and a dark, tar-like fluid also makes its appearance. If the needle used be made of steel or any other readily soluble metal, further changes occur at the positive pole due to the production of salts of iron with the acids liberated from the blood. These changes are spoken of as secondary electrolysis. The clot formed by electrolysis is, therefore, not composed simply of the fibrine of the blood, but contains also a large proportion of albumen coagulated by the chemical action of the current, and must be looked upon as a foreign body around which we hope ordinary coagulation will occur.

The operation of galvano-puncture is best performed as follows. Two steel needles, well insulated with vulcanite or gum-elastic, are inserted into the sac of the aneurism and connected with the opposite poles of the battery. The needles should be about one inch apart, parallel to each other, and so inserted that no part of the uninsulated portion of the needle shall touch the sac. The best battery for the purpose is Foveau's modification of Smee's, of which from ten to twenty-five cells may be used for a time varying from twenty minutes to half an hour, or more—according to the effect produced. If the tumour be sufficiently near the surface to be clearly observed, as has been the case in several of the aneurisms in which the treatment has been employed, it will be seen to become more tense and firm, and the expansile nature of the pulsation will become diminished as the operation progresses. Sometimes bubbles of gas escape by the side of the negative needle, and a little thick brown fluid oozes up. Occasionally the tumour has been found to swell and become resonant on percussion. When a distinct effect has been produced the needles may be withdrawn, and the small punctures closed with lint and collodion. The negative needle will be found unaltered, while the positive will be corroded directly in proportion to the amount of electrolytic action that has taken place. In order to prevent this corrosion of the positive needle, it has been suggested by Dr. John Duncan that platinum may be used instead of steel. There is no evidence, however, to prove that the salts of iron produced give rise to any particular danger; in fact, it is probable they aid considerably in the formation of the firm coagulum surrounding the needle. The battery used in the operation is of considerable importance. It has been pointed out by Ciniselli, that a current of high tension and somewhat low intensity is less likely to cause the production of undue heat during the operation, and consequently less prone to lead to inflammation and suppuration of the sac. A battery, therefore, composed of a large number of small elements is superior to one of a few large elements, and all the requisite conditions are found best to be fulfilled by Foveau's modification of Smee's. Some operators, and especially Bastian, have advocated the introduction of the positive pole only, the negative being attached to a sponge or metal plate laid on the skin near the aneurism. The only objection to this mode of treatment is the excessively small effect produced. The electrolytic action which takes place is directly in proportion to the intensity of the current; and by the introduction of a considerable mass of the tissues of the patient in the circuit, the resistance is so greatly increased that electrolysis is reduced to a scarcely appreciable amount, the positive needle appearing almost unchanged after the operation. Others, again, have introduced the negative needle only, but as the coagulum formed at the negative pole is soft and frothy, but little good can be expected from this mode of operating. Dr. Julius Althaus, who has superintended the operation in five cases, is strongly of opinion that "the most effective application of the current is that where both poles are inserted into the sac." Ciniselli operated in this way, and Drs. Duncan and Fraser, to whom we are indebted for many important observations on galvano-puncture and for the invention of reliable insulated needles, support the same view. The operation is accompanied by but little pain, and it is only occasionally that chloroform is needed. The effect of a single operation is seldom sufficient to cause any marked improvement in the condition of the patient, and it requires usually to be repeated several times.

The clot formed as the result of galvano-puncture is somewhat soft and yielding, and unless supported by a moderately firm sac soon flattens out or disappears, and the condition of the aneurism becomes much the same as it was before the operation. Little more than the most temporary relief can for this reason be expected in many cases; and whenever the aneurism has become diffused, the operation can only be productive of mischief by hastening the inflammatory changes occurring round the sac. It might be supposed that so soft a clot would readily break up, and that the danger of embolism would be great in consequence; but experience has shown it is not so, no such accident having happened in any of the recorded cases. Suppuration of the sac has occasionally occurred, but its occurrence has been much less frequent since the principles of the operation have been more fully understood. The formation of sloughs round the needle-punctures, and consequent hæmorrhage, has not been noticed except when the needles have been imperfectly insulated. In fact, it may be said that in almost every case, even when the operation has failed to give relief, it has at any rate done no harm.

The statistics of the operation have not been fully compiled, but the general results of the published cases have not been unfavourable when we consider the hopeless nature of the cases in which it has been performed. Of 13 cases of aneurism of the aorta treated by Ciniselli's method, five were cured, and no evil consequences followed in any case. Of the same number which have been operated on in this country during the last few years, none have been cured, but at least six experienced more or less relief; and in almost all, it may be said, the operation only aimed at relief, the disease being too advanced to warrant any hope of cure. About sixty other cases of aneurism of various arteries have been collected by Ciniselli as having been operated on before 1868; but in these the methods used were so imperfect, that they cannot be fairly considered as bearing upon the question at the present time.

When we compare galvano-puncture with ligature or compression in the treatment of external aneurism, it is, I think, impossible to hesitate for a moment in giving a decided preference to the latter modes of treatment, as the results that have hitherto been obtained are not such as would justify a prudent Surgeon in submitting his patient to an operation of this kind, when he possesses such certain and comparatively safe modes of treatment as deligation or compression. In internal aneurisms, or in those cases in which the disease is so situated at the root of the neck, that the artery can neither be ligatured with safety nor compressed, galvano-puncture is certainly justifiable, especially when conjoined with proper medical treatment, as we have ample proof that with the knowledge and means now at our disposal we can perform the operation with scarcely any danger to the patient, and in favourable cases with much hope of relief. Much will depend upon the selection of the case. Ciniselli has pointed out that the conditions favourable to success, are that the aneurism shall be sacculated and opening into the vessel by a narrow mouth, of slow growth and of medium size, and, when thoracic, situated entirely within the thorax, and that it shall not in any serious way have interfered with the general health of the patient. These conditions seldom occur; and when they are absent, the most that can be hoped for is temporary arrest of the progress of the disease and some relief to the patient's sufferings.

INJECTION WITH PERCHLORIDE OF IRON.—The injection of aneurismal sacs with a solution of the perchloride of iron has also been practised, with the view of coagulating their contents; such treatment, however, is attended with great risk of embolism, and is in every way vastly inferior to the ligature or compression of the artery leading to or beyond the sac, and should never be employed if these can be practised.

Aneurism of the gluteal artery has been successfully treated by injection of the perchloride of iron in at least one case. In cases, however, in which, either from the situation of the disease, its complication with other and extensive disease of the arterial system, or its multiple character, ligature and compression are not applicable, an endeavour might be made to procure the arrest of the blood in the tumour by distal compression of the artery, before attempting to coagulate its contents by injection of the perchloride; and I cannot but think that a satisfactory result might thus be obtained.

**Hypodermic Injection of Ergotin.**—Langenbeck advocated the hypodermic use of a watery extract of ergot in cases of aneurism, under the impression that it might act on the muscular fibres scattered over the sac of the aneurism in the same way as it acts on the muscular fibres of the uterus, and by causing contraction might gradually diminish the size of the aneurism, if not cure it. He seems to have tried it in two cases only. One was an aneurism in the supraclavicular region (exact nature not mentioned), which had been previously treated with moxas, and almost cured. The symptoms having returned, hypodermic injections of ergot were tried. The quantity injected varied from about ½ grain to 3 grains of Bonjean's watery extract of ergot, diluted with three times as much spirit and glycerine. The injections were repeated every three or four days. Decided improvement is said to have occurred, but pulsation never quite ceased. The improvement commenced after the second injection. No unpleasant symptoms occurred after the injections. In the second case a man, aged 42, had a sacculated aneurism of the radial artery of the size of a hazel-nut. An injection of two grains and a half of the watery extract cured it in one day, as the next day it could not be felt. The injection gave rise to some inflammation of the surrounding cellular tissue, which disappeared in a week.

This accident I have seen happen in one case in which I tried it, but no good resulted from this treatment, which cannot, indeed, on pathological grounds, be considered to be of a hopeful character.

MECHANICAL MEANS of various kinds have been used with the view of producing an artificial coagulum in the aneurism, and thus leading to its cure. Thus coils of horse-hair, cat-gut, or iron-wire have been thrust into and left in the sac, through a puncture made in it. It is scarcely necessary to say that such means of cure are as useless as they are unscientific.

## ARTERIO-VENOUS ANEURISM.

Preternatural communication between arteries and veins, though usually the result of wounds, occasionally happens from disease; ulceration taking place between the vessels, and thus causing an aperture to lead from one into the other. When such communications are of a traumatic character, they may, as has already been stated, constitute either an *Aneurismal Varix* or a *Varicose Aneurism.* As the result of disease, aneurismal varix only can occur, varicose aneurism never happening except as a consequence of wound. These spontaneous communications have been met with between the aorta and the vena cava, and between the iliac, femoral, carotid, and subclavian arteries and their accompanying veins. In nature, symptoms, course, and treatment, they so closely resemble traumatic aneurismal varix, described at page 317, vol. I., that their consideration need not detain us here.

# SPECIAL ANEURISMS.

## CHAPTER XLIV.

## ANEURISMS OF THE THORAX, HEAD AND NECK, AND UPPER EXTREMITY.

### ANEURISM OF THE THORACIC AORTA.

SYMPTOMS.—The symptoms of Intrathoracic Aortic Aneurism are of two kinds : *auscultatory* and *rational.*

The **Auscultatory Signs** vary greatly in distinctness, and even in presence. In some cases, more especially in fusiform aneurisms, they are almost from the first of a very marked and obvious character ; in others, especially in sacculated aneurisms, they are absent throughout, the aneurism terminating fatally without its existence having been determined by the stethoscope. They consist in murmurs of various kinds and degrees of intensity, bellows, rasping, or whizzing ; in the second sound of the heart being audible over a greater space than normal. At the same time there may be dulness on percussion. These various signs may often be heard more distinctly upon or to the left side of the spine, than at the anterior part of the chest ; when occurring anteriorly, they are chiefly met with on the right side.

The value of the auscultatory signs in the diagnosis of aneurism within the chest is not perhaps so great as in many other thoracic diseases, in the early stages of the affection, and in those cases in which the aneurism continues small and sacculated throughout, or is so deeply seated as not to approach the parietes of the chest. This need not be a matter of surprise, when we reflect how deeply the ascending portion of the aorta and the arch are situated ; how they are covered in front by the lungs and loose areolar tissue, through which sound is with difficulty transmitted ; and how they are covered in behind by the spine and its muscles. When, in addition to this, it is borne in mind that aneurisms of the arch often prove fatal by bursting into contiguous cavities and canals before they have attained a size greater than that of a walnut or a pigeon's egg, and thus are incapable of furnishing a murmur of any very marked kind, it can be easily understood that the value of auscultation is but small in many cases of thoracic aneurism.

The **Rational Signs** of intrathoracic aortic aneurism are of three kinds :— Pressure-Effects ; Pulsation ; and Tumour.

**Pressure-Effects** may be exercised on any of the contiguous structures ; and a glance at the anatomical relations of the thoracic aorta, more particularly the arch, will enable the Surgeon to judge of their complexity and importance. They will necessarily vary according to the size of the aneurism and the portion of the aorta affected by it; more according to the latter than to the former condition. When the aneurism arises from the *root of the aorta,* and more especially when it is intrapericardial, it is usually of small size, and its pressure-effects will be little obvious. When the aneurism arises from the *termination of the arch,* or the *descending aorta,* it may often attain a considerable amount of development without any very obvious pressure-effects being induced. Aneurisms that are situated *within the concavity of the arch* necessarily give rise to very severe effects, by the compression they must exercise upon some one or other of the very important structures that are spanned by and included within the aortic arch. When the *anterior part of the aorta* is affected, the aneurism may attain a very considerable bulk, even coming forward so as to project and pulsate between the intercostal spaces, without any very noticeable pressure-effects being induced. But when the *posterior wall of the artery* is the seat of the disease, then severe symptoms are early set up by the compression and erosion of the structures lying contiguous to the artery and along the spine (Fig. 372). When the *upper part of the aortic arch* is the seat of aneurism, a peculiar train of cerebral symptoms, such as vertigo, insensibility, or defective vision, may be induced by its interference with the circulation through the carotids.

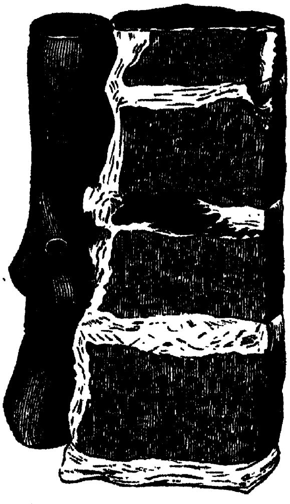


Fig. 372.—Erosion of Intervertebral Substance by a small Aneurism of Descending Aorta pressing backwards.

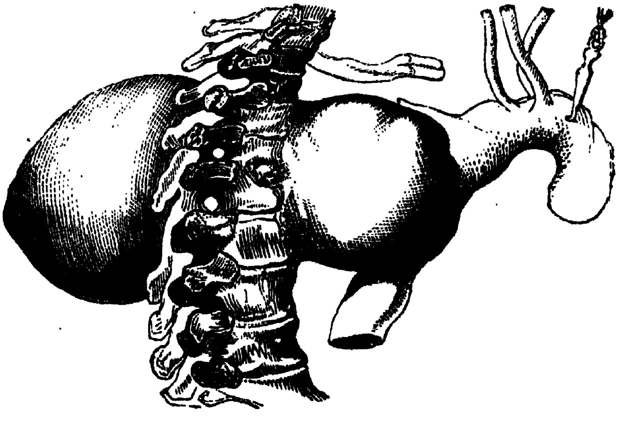


Fig. 373.—Aneurism of Descending Aorta, eroding and traversing Vertebræ.

The pressure-effects that need chiefly engage our attention, are :—1, Pain; 2, Dyspnœa; 3, Dysphagia; and 4, Œdema.

1. **Pain** is usually one of the earliest symptoms of intrathoracic aneurism, and is frequently of great value in a diagnostic point of view, as it is often most marked when the other symptoms are the least developed.* It is generally more severe in sacculated than in fusiform aneurisms, and when the posterior rather than the anterior aspect of the vessel is the seat of disease. The pain, as has been pointed out by Law, is of two distinct kinds. The first kind is

lancinating, intermittent, and neuralgic in its character, evidently dependent upon pressure on the spinal or sympathetic nerves. This pain is chiefly seated on the left side, and shoots up the side of the head and face, along the upper arm to the elbow, along the intercosto-humeral nerve, through the chest, or between the scapulæ. The second form of pain usually occurs at a later stage of the disease, is continuous, and of a boring, hot, or burning character. It seems to depend upon the perforation of the tissues, more especially the bones, by the aneurismal tumour, and chiefly occurs on the right side of the chest (Fig. 373).

2. **Dyspnœa** is of very frequent occurrence in intrathoracic aneurism ; in all probability it is more uniformly met with than any other single symptom. It may arise from five distinct conditions, and its characters vary with its cause.

α. *From direct pressure on the trachea.* In these cases the dyspnœa is attended by much and constant wheezing, cough, often by whistling sounds in the chest and tubular respiration, and by slow expansion of that cavity. There is usually expectoration of thick tenacious or ropy mucus.

β. *From direct pressure on a bronchus* (Fig. 374). In these cases there are wheezing, cough, and some degree of expectoration, with perhaps diminished respiratory murmur in the side affected, and puerile respiration in the opposite lung, as has been pointed out by Stokes.

γ. *From pressure upon the lung.* In these cases the respiration is comparatively little interfered with, the spongy tissue of the lung accommodating itself and yielding to the pressure of the tumour. After a time, the pulmonic tissue will become incorporated with the wall of the sac ; and then more serious difficulty in breathing, with hæmoptysis, will supervene.

δ. Dyspnœa may be, and very commonly is, induced by *irritation, compression, flattening out, or stretching of the left pneumogastric and recurrent laryngeal nerves,* by the pressure of the tumour. In these cases the larynx becomes the seat of the difficult respiration, its muscles being driven into a state of spasm, so as to occasion paroxysmal attacks of intense difficulty of breathing. The voice becomes hoarse, croupy, or croaking ; the cough has a loud croupy or metallic sound, and is attended by the expectoration of thin frothy mucus. The laryngeal spasm and stridor often do not occur in ordinary respiration, but are produced under

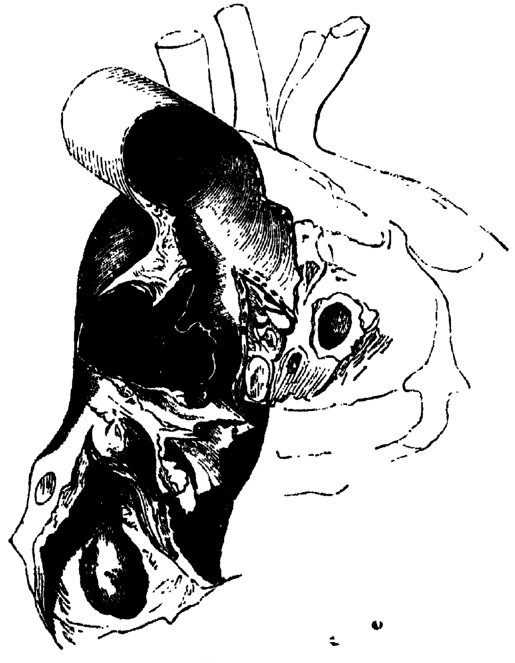


Fig. 374.—Aneurism of Arch of Aorta, of the size of an almond, springing from below left Subclavian Artery, and bursting into left Bronchus.

exertion, or on making the patient inspire fully and deeply. The laryngeal symptoms are sometimes so much more prominent than any of the other signs of intrathoracic aneurism, and so closely resemble chronic or even acute laryngitis, with impending asphyxia, that there are not a few cases on record in which Surgeons have performed tracheotomy, on the supposition that they had to do with cases of pure and uncomplicated laryngeal disease; and in other instances this operation has been performed with the view of prolonging life, even when the dependence of the laryngeal spasm on aneurism of the aorta has been recognised.

Dr. George Johnson has made some important observations on the use of the laryngoscope in the diagnosis of the cause of dyspnœa in aortic aneurism. He says that, in cases where the cause is pressure on the recurrent laryngeal nerve, the larynx is seen to be healthy, and the spasm may be seen to occur. If the pressure be sufficient to abolish the function of the nerve, unilateral paralysis will occur, which can easily be ascertained by laryngoscopic examination. The voice in such cases is weak and husky; whereas, in cases in which the pressure is on the trachea, its character is unchanged. When a thoracic aneurism presses the trachea against the spine, the tracheal stridor and the voice-sound are heard with remarkable distinctness on applying the stethoscope over the upper dorsal vertebræ—the sound being conducted through the bones.

ε. Dyspnœa may be dependent on the *compression of the pulmonary vein* by the aneurismal tumour. In cases of this kind there would be considerable lividity of surface, and signs of pulmonary congestion.

The dyspnœa of intrathoracic aneurism will often be sufficiently intense to occasion death. It may be mistaken for ordinary asthma; but the diagnosis can usually be effected, by observing that in aneurism the paroxysms of dyspnœa often come on in the day as well as at night, and are greatly increased by change of position, as by placing the patient either upright or recumbent, the tumour thus shifting its point of pressure. It is, as Bellingham has pointed out, not influenced by atmospheric changes, and is generally associated with laryngeal stridor or spasm. When such symptoms as these are associated with pain and dysphagia, they point very strongly, even in the absence of all auscultatory signs, to the presence of an aneurismal tumour.

Aneurisms situated within the concavity or springing from the posterior parts of the aortic arch are those which, either directly by their pressure on the air-tubes or the pulmonary veins, or indirectly by the influence they exercise on the recurrent laryngeal nerve, are chiefly associated with dyspnœa.

3. **Dysphagia** is a symptom of sufficiently frequent occurrence in aortic aneurisms. Eaton has determined its existence in nine out of twelve cases. It seldom occurs, however, in the earlier stages of the disease, or when the aneurism is small, and hence is of much less diagnostic value than dyspnœa. When, however, it is associated with that symptom, the combination becomes important; as the co-existence of the two conditions clearly points to the compression of the œsophagus and the air-tubes by a tumour, which other diagnostic signs may prove to be aneurismal.

It is of importance to bear in mind that in some aneurisms, especially of the descending thoracic aorta, dysphagia may be one of the most marked signs. In such cases as these, stricture of the œsophagus has erroneously been supposed to exist, and the patient has even been treated by the introduction of bougies on this supposition—an error of practice that has terminated fatally by the perforation of the aneurismal sac, where it projected against the œsophagus, by the point of the instrument.

The difficulty in deglutition in cases of compression of the œsophagus by aortic aneurism, is almost invariably referred to the episternal notch. The dysphagia is commonly associated with pain, or with the sensation of a cord drawn tightly around the body.

4. **Œdema,** with more or less lividity of the upper extremities and head and neck, occasionally but rarely occurs. It is generally most marked on the left side, and arises from the compression of the superior cava or the innominate veins by aneurisms springing from the fore or upper part of the arch.

**Pulsation** and **Tumour**, in intrathoracic aortic aneurism, so far as they are observable externally, are always absent in the early stages of the disease, and very frequently continue so throughout the progress of the affection; indeed, in aneurisms springing from the intrapericardial aorta or the concavity of the arch, death usually takes place, either by rupture into one of the serous cavities or the air-tube, or by the exhaustion induced by dyspnœa, long before the aneurism has attained a sufficient size to be recognisable externally. There are, however, three portions of the thoracic aorta which, when affected by aneurism, yield external evidence by the existence of pulsation or tumour of the true nature of the disease. These are—1, the anterior aspect of the ascending aorta; 2, the summit of the arch; and 3, the posterior aspect of the descending aorta.

1. When the aneurism is situated *in the anterior aspect of the ascending aorta and commencement of the arch*, pulsation may be detected by pressure between the intercostal spaces on the right side of the sternum, and a thrill, as well as distinct impulse, may often be felt over that side of the chest, before any external tumour becomes visible; thus simulating the beat of the heart, in addition and opposite to the seat of the true cardiac impulse. As the aneurism increases an external tumour appears, the wall of the chest becoming absorbed and perforated opposite the point of greatest impulse.

2. When an aneurism springs from *the summit of the arch*, a pulsating tumour appears at the root of the neck, behind or even above the margin of the sternum, most commonly towards the right side, and occasionally rises so high out of the thorax, and is so distinctly felt in the neck, as to run the risk of being confounded with aneurism of the brachio-cephalic or carotid arteries (Fig. 379, p. 87). This error, which has frequently been committed, and which has led to operations on the arteries at the root of the neck, may usually be avoided, except in the case of the brachio-cephalic, by the impossibility of tracing with the finger the lower boundary of the tumour, and the existence of distinct dulness on percussion, possibly of impulse or of auscultatory evidence of aneurism, below the level of the upper margin of the sternum or clavicle.

3. When aneurism springs from the *posterior wall of the descending aorta*, a pulsating tumour may gradually develop itself to one side of the spine or

under the scapula, commonly on the left side; and it may attain an excessive development, fully as large as the head, before the patient is destroyed by the rupture of the tumour externally.

Surgical interference usually avails but little in aneurisms of the thoracic aorta, and in many cases it is more humane to allow the patient to die in peace than to torture him by any experimental surgery, which may only tend to hasten the fatal termination of the case. The only treatment adapted to all cases is constitutional, conducted on the principles laid down in pp. 33—35, and no operative procedure is justifiable before this has had a fair trial.

Cases do, however, arise in which relief at least may be hoped for as the result of operative interference. The interesting pathological observation having been made by Dr. Cockle, that if the left carotid artery became occluded, there was a tendency to spontaneous cure in an aortic aneurism situated at its cardiac side, it was determined to make a direct application of this observation to practice by tying the left common carotid in aneurisms of the first and second parts of the aortic arch. Accordingly in 1872 Christopher Heath ligatured the left carotid with much benefit to the patient in a case of aneurism of the ascending and transverse aorta under the care of Dr. Cockle.

Other Surgeons have tried to obtain consolidation of the tumour by endeavouring to coagulate its contents by thrusting coils of iron-wire or cat-gut into its interior, but it need scarcely be said that in no case has any permanent success attended such operations.

The mode of treatment which has been more frequently adopted than any other is galvano-puncture; and it seems probable that in well-selected cases this may be productive of considerable good, or even occasionally lead to a complete cure. In 27 cases of aortic aneurism thus treated, which have been collected by John Duncan, 5 were cured, 10 relieved, 9 unrelieved, and 3 died. Experience has shown that with the latest improvements in the operation—well insulated needles and a suitable battery—there is scarcely any danger to life, and that even where it does no good it does no harm. It has been applied in all stages of the disease, from the time when the tumour becomes sufficiently superficial to allow the safe introduction of the needles, to the time when it has perforated the chest-wall, and is on the point of bursting. In one of John Duncan's cases, the life of the patient was undoubtedly prolonged for nearly three months after the time at which, if left to itself, the aneurism would have burst externally. The cases best suited for galvano-puncture, and in which even a cure may be occasionally hoped for, are those in which the tumour is of slow growth, has not yet perforated the chest-wall, and in which it can be diagnosed as sacculated and communicating with the aorta by a comparatively small opening. It is important also that the patient's health should not be too much broken by suffering or visceral disease. When the tumour projects through the parietes of the thorax, forming a secondary sac outside, the prospect of cure is infinitesimally small; but even then, progress may be delayed, and much relief given to the patient. If the tumour have become diffused, as may occur when it points at the back, galvano-puncture can only do harm by increasing the tendency to inflammation and suppuration already existing. For the details of the operation, see page 64.

There is one point in the treatment of some forms of aortic aneurism, that falls more within the province of the Surgeon, and on which his opinion may be sought. I mean the advisability of opening the windpipe, to relieve the patient from the distress occasioned by the laryngeal spasm that commonly attends many of these cases. The decision of this question is always an anxious one; for it must be borne in mind that, as the disease that occasions the spasm of the larynx is necessarily and inevitably fatal, the operation can only be expected to give temporary relief, and perhaps but a brief prolongation of life.

In determining this question, the Surgeon must bear in mind that simple laryngeal spasm is rarely, if ever, the cause of death in aortic aneurism; that, although the patient may suffer greatly from this complication, he does *not* die of it; but that the ultimate cause of death is usually intrathoracic pressure, rupture of the sac internally or externally, or exhaustion. The operation, therefore, would be justifiable in those cases only in which it could be determined that the spasmodic dyspnœa was purely laryngeal, and was not dependent on compression of the air-passages within the chest by the aneurismal tumour, but simply on the irritation produced by the implication of the left recurrent laryngeal nerve. Such cases are very rare pathologically, and necessarily most difficult of accurate diagnosis. As the Surgeon will usually get the credit of having killed the patient if he be induced to perform the operation, and the relief be not immediate and great, I would advise him not to operate unless the diagnosis be most clear, or in circumstances of imminent death from laryngeal spasm, with the view of affording immediate, even if it be temporary, relief. If any operation be done, it should certainly be laryngotomy, and not tracheotomy.

### ANEURISM OF THE INNOMINATE ARTERY.

Aneurisms of this artery may be either of the tubular or the sacculated kind, and usually give rise to a train of serious and dangerous symptoms, from their pressure upon important parts in their neighbourhood. Indeed, a glance at the relations of this artery will show the important effects that must be produced by the pressure of a tumour springing from it. Before it lies the left innominate vein; to the outer side or behind, the superficial cardiac nerve; to its left is found the trachea, and more posteriorly the œsophagus; on its right are the innominate vein of that side, and the summit of the costal pleura; externally and posteriorly it is in relation with the pneumogastric, and more posteriorly and internally it lies below the right recurrent laryngeal nerve.

SYMPTOMS.—The general symptoms of an aneurism of this artery are the existence of a pulsating tumour of a globular shape behind the right sterno-clavicular articulation, attended with pain, and perhaps œdema of the right side of the face and arm, with some difficulty in respiration, laryngeal cough, and dysphagia. The tumour is usually soft and compressible, filling up more or less completely the hollow above the sternum, and even rising as high in the neck as the lower margin of the cricoid cartilage; it pushes forwards, first the sternal, and afterwards the clavicular portion of the sterno-mastoid muscle, and has occasionally been seen to extend into the posterior inferior triangle of the neck; and, indeed, is generally most distinctly defined towards its brachial aspect. In some cases no tumour rises into the neck, but the sternum, clavicle, and costal cartilage of the first rib, are found to be considerably pushed forwards beyond their natural level. In the space around the right sterno-clavicular articulation, and about the upper part of the sternum, there will be dulness on percussion. In very many instances there is no bruit, but merely a strong impulse with the heart's sounds, as distinct as in the cardiac region, or even more so ; but in other cases there is every variety of bruit.

**Pressure-Effects.**—The most important symptoms are occasioned perhaps by the pressure-effects of the tumour upon the neighbouring parts, affecting the pulse, the venous circulation, the nerves, respiration, and deglutition.

The **Pulse** is usually influenced, being much smaller and feebler in the radial artery of the affected than of the sound side, and in some instances being completely arrested ; owing, doubtless, to the occlusion of the subclavian. The pulsation in the right carotid and its branches is also frequently much less powerful than in the opposite vessel. These signs commonly occur before any external tumour is seen or can be felt, and hence constitute an important element in the early diagnosis of the disease.

**Enlargement of the Superficial Veins** of the neck and right upper extremity is of frequent occurrence, the external jugular being the vessel that is usually first dilated ; at a more advanced period the superficial subcutaneous veins of the upper part of the right side of the chest often become tortuous and form a dense plexus in this situation, while many anastomose with the cephalic and thoracic veins above, and the superficial epigastric below. As the pressure increases, œdema commences in the right eyelids and hand, and may speedily extend to the whole of the head, face, and arm, which become hard and brawny in consequence of serous infiltration. In one instance I have seen the left arm become suddenly œdematous, the left innominate vein being pressed upon. In these cases the eyes become staring and prominent, and the lips, nose, and features livid and turgid with blood, as well as œdematous, so as to greatly alter the expression of the countenance.

**Pain** of a dull aching character is experienced in the situation of the tumour, from the compression of the neighbouring structures. But, early in the disease, and among some of the first symptoms, the patient often experiences sharp shooting pains, apparently of a rheumatic or neuralgic character, in the arm and the side of the head and face, arising from pressure upon, and irritation of, nerves of the cervical and brachial plexuses. Taking the course of the ascending and descending filaments of the cervical plexus, the pain shoots up the side of the head and neck, over the shoulder and upper part of the chest ; or, from pressure upon the brachial plexus, it radiates down the hand and arm, being usually especially severe about the elbow and fingers. The muscular power of the right arm also commonly becomes impaired.

**Dyspnœa** is of very common occurrence, and of very varying degrees of intensity, from slight difficulty in breathing up to fatal asphyxia. It may proceed either from irritation of the larynx, in consequence of compression of the recurrent nerve ; or from pressure on the trachea. When it depends on laryngeal irritation, the voice is hoarse, husky, or whispering ; and there is a dry, croupy, and paroxysmal cough, usually accompanied by expectoration of thin frothy mucus. In these cases, after death, the recurrent nerve will be found to be stretched out and greatly elongated by the pressure of the tumour (Fig. 375). Compression of the trachea, which becomes flattened and curved over to the left side by the protrusion of the tumour, is a common cause of dyspnœa, and is not unfrequently associated with the laryngeal irritation. More rarely by far, the right bronchus is compressed by the extension of the tumour downwards.

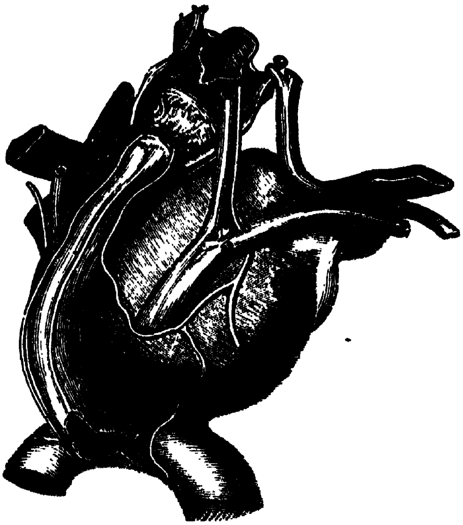


Fig. 375.—Aneurism of the Innominate Artery compressing and stretching the Recurrent Laryngeal Nerve, and pushing the Trachea to the Left Side. (Back View.)

**Dysphagia** is of sufficiently frequent occurrence, and varies from slight uneasiness in deglutition to an impossibility of swallowing anything except fluids. I have never seen it occur without having been preceded by dyspnœa; and, in every instance that has fallen under my observation, it has been associated with laryngeal irritation. The coincidence of these two symptoms is readily explained by the anatomy of the parts; the recurrent nerve, lying between the sac and œsophagus, must suffer compression before the mucous canal be interfered with.

PROGNOSIS.—The prognosis of brachio-cephalic aneurism is in the highest degree unfavourable, though the disease frequently does not run a rapid course. If it extend upwards and outwards, the tumour may acquire a very large size before any very important organ or part is implicated; but if it press backwards and inwards, it may prove fatal at any early period. I know of no case in which such an aneurism, if left to itself, has undergone spontaneous cure, and but few instances in which the rupture of the sac has taken place. The most frequent cause of death is asphyxia, from spasmodic closure of the larynx induced by irritation of the recurrent nerve; or from pressure on the trachea.

DIAGNOSIS.—The diagnosis of innominate aneurism is usually sufficiently easy, if attention be paid to the symptoms that have just been detailed. But at times the difficulty is unavoidably so great as to baffle the most sagacious Physicians and most experienced Surgeons; that which has during life been considered to be an aneurism of the innominate artery, having, after death, proved to be one of the summit of the aortic arch rising up into the root of the neck behind the right sterno-mastoid, or overlapping the brachio-cephalic trunk. The task of overcoming this difficulty in diagnosis must be left to the tact of the Surgeon. But it is impossible to over-estimate its importance, when the question of ligaturing the arteries at the root of the neck for a supposed innominate aneurism is contemplated; for, in at least three out of the nine cases in which this operation has been done, the arch of the aorta has been found to be the seat of disease; in two of the cases the innominate being unaffected by aneurism. And I am acquainted with a fourth case, in which the operation was commenced, but was abandoned, as the subclavian could not be reached; the patient dying a few days afterwards, the aneurism was found to be aortic, rising up into the root of the neck, the innominate being sound.

TREATMENT.—There are several instances on record in which a properly conducted course of constitutional treatment has cured the patient: thus a case of Luke's was permanently cured by small and repeated bleedings, conjoined with the administration of digitalis. In connection with such treatment, distal pressure might be employed, as in a case that derived benefit from this plan in Syme's hands.

In aneurism of the innominate, the vessel is so short, and the sac so situated, that it is impossible to attempt to apply a ligature on the cardiac side of the tumour. What resource, then, does surgery offer in these cases beyond the employment of constitutional and dietetic means? It may be answered to this, that, if these measures fail in arresting the disease, our choice must lie between two alternatives; leaving the patient to his fate, or having recourse to the application of the ligature on the distal side of the tumour. On looking on the innominate artery with reference to the distal operation, we are struck by two peculiarities in the vessel, which must necessarily modify to a considerable extent not only the seat of the operation, but the principle on which it is conducted. The first peculiarity to which I allude is the shortness of the trunk, which makes it impossible to apply the ligature to the vessel itself, but renders it necessary to deligate one or both of its terminal branches. The other peculiarity is, that in no circumstances can these vessels be so ligatured as to arrest the whole of the blood sent into the artery; for, although the circulation through the carotid may be entirely stopped, yet it is impossible, from the seat and extent of the disease, to tie the subclavian at any point except beyond the scaleni; hence that blood which is destined for the supply of the branches of this vessel—the vertebrals, the thyroid axis, the internal mammary, and the first intercostal—must continue to be propelled into and through the sac. Three distinct modifications of the distal operation have been proposed and resorted to for the cure of aneurisms in this situation: 1. Ligature of the Subclavian alone; 2. Ligature of the Carotid alone; and 3. Ligature of Both Vessels with an interval of greater or less extent.

1. **Ligature of the Subclavian only** (Fig. 376, p. 80) has been practised in four cases, the results of which are exhibited in the following Table; two were soon fatal, and the partial success in one of the other cases may be fairly attributed in a great measure to the accident of the carotid having been occluded. The results of this practice have certainly not been sufficiently favourable to justify the Surgeon in repeating an attempt of this kind, opposed as it is to the known principles on which the distal operation effects a cure. For, supposing, as we may safely do, with Wardrop, that only one-third of the blood that is sent into the innominate finds its way through the extrascalenal portion of the subclavian, the remainder being destined for its branches and the carotid in equal proportions, what fact can be adduced or principle laid down from which we can expect to obtain the cure of an aneurism in close proximity to the heart, by cutting off so small a proportion as one-third of the supply of the blood sent into it?

ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF SUBCLAVIAN ONLY.

| OPERATOR. | SEX. | AGE. | RESULT. | CAUSE OF DEATH. | REMARKS. |
|---|---|---|---|---|---|
| 1. DUPUYTREN. | m. | 40. | Died on ninth day. | Exhaustion, following cough and secondary hæmorrhage. | Subclavian ligatured immediately above clavicle. Tumour diminished, but pulsations continued. Aneurism of subclavian, with dilatation of innominate and aorta. |
| 2. WARDROP. 1827. | f. | 45. | Died two years after operation. | Exhaustion. | Subclavian ligatured beyond scaleni; the pulsations in and size of tumour diminished, and respiration became freer; on the ninth day pulsation reappeared in right carotid, in which it had previously been absent. (We may ascribe success of operation to this circumstance.) |
| 3. LAUGIER. 1834. | m. | 57. | Died a month after operation. | Asphyxia. | Vessel ligatured immediately above clavicle. Aneurism of brachio-cephalic; aorta was dilated, and right carotid obliterated by the pressure of the tumour. |
| 4. BROCA. 1862. | m. | 50. | Died six months after operation. | Gangrene of lung. | Tumour had not much diminished, but became harder. Afterwards increased in size. |

2. **Ligature of the Carotid only** (Fig. 377, p. 80) has been practised in about twenty-four cases, as recorded in the annexed Table, and in one case only does the disease appear to have been materially benefited; and in that instance the good effects can scarcely be attributed to the operation, but must rather be looked upon as an effort of nature to effect a spontaneous cure, the sac becoming inflamed and suppurating, and the arteries of the arm and head on the side affected undergoing obliteration. Key's patient died in consequence of the left carotid becoming occluded, and the brain being deprived of its proper supply of blood. And in several other cases death is referred to hemiplegia and other cerebral diseases.

ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF CAROTID ONLY.

| OPERATOR. | SEX. | AGE. | RESULT. | CAUSE OF DEATH. | REMARKS. |
|---|---|---|---|---|---|
| 1. EVANS. 1828. | m. | 30. | Recovered: living in 1863—thirty-four years after operation. | . . . | Tumour diminished for a few days after operation, but at end of seven days inflammation of the sac set in, followed by obliteration of arteries of right arm and the branches of the carotid. At the end of a year tumour still existed, with constant pulsation. Next year the sac suppurated, and discharged much pus. |

## ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF CAROTID ONLY—(*continued*).

| OPERATOR. | SEX. | AGE. | RESULT. | CAUSE OF DEATH. | REMARKS. |
|---|---|---|---|---|---|
| 2. MOTT.<br>1829. | m. | 55. | Died seven months after operation. | Asphyxia. | After operation, radial pulse on affected side disappeared; and tumour in neck was much diminished. After death, no external appearance of tumour; internally it was as large as a double fist. |
| 3. ASTON KEY.<br>1830. | f. | 61. | Died four hours after operation. | Narrowing of vertebral arteries; brain not receiving sufficient blood for its functions. | Aneurism of innominate and of arch of aorta found. The orifice of left carotid nearly occluded, and vertebrals smaller than natural. |
| 4. NEUMEISTER.<br>1830. | m. | 51. | Death fifth day. | Hemiplegia. | Aneurism confined to innominate. Cerebral symptoms set in on fifth day. |
| 5. MORRISON.<br>1832. | m. | 42. | Recovered from operation, died twenty months afterwards. | Suddenly; cause not stated. | Aneurism of innominate and carotid found. Arch of aorta diseased. Right carotid dilated into a sac as high as part ligatured, and plugged by dense fibrinous laminæ. |
| 6. DOHLHOFF.<br>1837. | f. | 37. | Death fifth day. | Hemiplegia and disease of brain. | Aneurism of innominate and root of carotid. Cerebral symptoms set in immediately. |
| 7. FERGUSSON.<br>1841. | m. | 56. | Died on seventh day. | Pneumonia. | Aneurism of innominate and subclavian tumour, and pulsation decreased after operation. Tumour nearly filled with firm laminated coagulum; no plug in carotid. |
| 8. HUTTON.<br>1842. | m. | 30. | Died on sixty-sixth day. | Bronchitis, inflammation, suppuration, and ulceration of sac into trachea. | Tumour diminished after ligature. Size and pulsation less. After death, tumour contained purulent matter and grumous blood; had opened into trachea. Right carotid and subclavian contained firm coagula. |
| 9. CORSA.<br>1842. | f. | 60. | Died on second day. | Diffuse cellulitis. | Aneurism of innominate and root of carotid. Subclavian and arch of aorta dilated. |
| 10. CAMPBELL.<br>1844. | m. | 48. | Died on nineteenth day. | Pneumonia. | Tumour began to disappear after the vessel was ligatured. After death, aneurism of innominate and transverse portion of arch, and dilatation of aorta as far as diaphragm. |
| 11. ROMPANI.<br>1844. | m. | 70. | Died on twenty-first day. | Secondary hæmorrhage, on sixteenth and nineteenth days. | Aneurism of innominate and carotid, nearly filled with fibrine. |
| 12. VILARDEBO.<br>1847. | m. | 70. | Died on twenty-first day. | . . . | Aneurism of innominate and carotid. Deposit of fibrine in sac. |

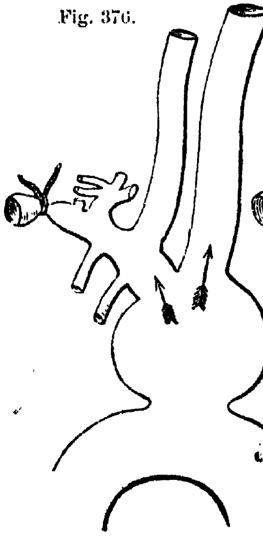
### ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF CAROTID ONLY—(*continued*).

| OPERATOR. | SEX. | AGE. | RESULT. | CAUSE OF DEATH. | REMARKS. |
|---|---|---|---|---|---|
| 13. **Wright.** (Montreal.) 1855. | m. | 70. | Died on sixtieth day. | Hemiplegia from cerebral abscess. | Tumour solidified by laminated fibrine. Subclavian pervious, with canal through tumour leading to it. |
| 14. **Broadbent.** 1860. | m. | 50. | Died on one hundred and fifteenth day. | Exhaustion, from secondary hæmorrhage. | No alteration produced in tumour by the ligature. Secondary hæmorrhage recurred several times. |
| 15. **A. Newton.** | m. | ... | Died on twelfth day. | Effusion into chest. | |
| 16. **Hutchinson** 1867. | m. | 48 | Died on forty-second day. | Asphyxia. | Aneurism of innominate, roots of carotid and subclavian and aortic arch, all filled with coagula. |
| 17. **Hewson.** 1867. | m. | 51. | Died on seventh day. | Pulmonary symptoms and asphyxia. | Aneurism of innominate and arch of aorta, partially filled with firm coagula. |
| 18. **Pirogoff.** | m. | abt. 40 | Recovered from operation. | . . . | Patient left hospital two and a half months after operation, when tumour was smaller, and the pulsation less marked; but aneurism not cured. |

Note.—In addition to the cases given in the table, a fatal case is recorded by John Scott (1834) and two by Nussbaum. All three died from rupture of the sac. Knowles records a case which terminated fatally from apoplexy, and O'Shaughnessey one in which galvano-puncture was unsuccessfully applied after the operation had failed to give relief. A fatal case is also attributed to Ordile (1859?) but no particulars can be ascertained. Porta once performed the operation, but after the death of the patient no aneurism was found. Holmes, after carefully investigating the evidence, is of opinion that the cases in the above table attributed to Rompani and Vilardebo are in reality only one case. In 1852? Pirogoff ligatured the left carotid in a case of aneurism of the aorta and innominate. The patient died hemiplegic. In 1873 Heath ligatured the left carotid in a case of innominate aneurism. The patient died almost immediately apparently from want of supply of blood to the brain. The right vertebral was obliterated, and the sac of the aneurism projected behind the right carotid, so as to interfere considerably with the flow of blood through it.

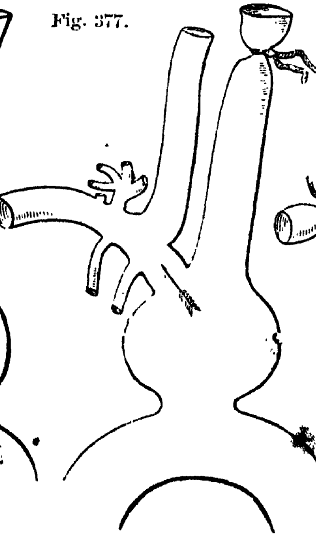
3. In fifteen cases **both the Carotid and Subclavian Arteries** have been

Fig. 376.



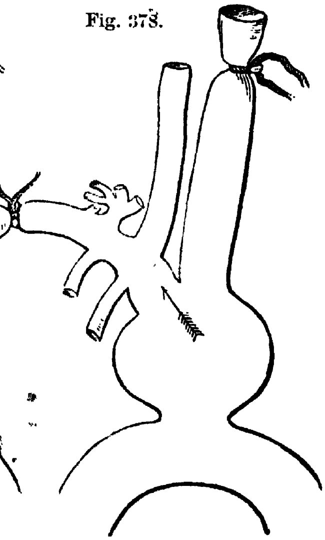
Brachio-cephalic Aneurism: Ligature of the Subclavian only.

Fig. 377.



Brachio-cephalic Aneurism: Ligature of the Carotid only.

Fig. 378.



Brachio-cephalic Aneurism: Ligature of the Subclavian and Carotid.

tied (Fig. 378). In one of the most favourable of these, that by Fearn, two years elapsed between the ligature of the carotid and that of the subclavian; the patient dying three months after the second operation: the sac was filled with laminated coagulum, and appeared to be undergoing spontaneous cure. (*See* Table, below.) The third case is remarkable as being the first instance in which both the vessels were tied simultaneously, and from the patient having lived for six days after the occlusion of all the arteries supplying the brain except the left vertebral. Heath's case is remarkable, as being the first in which simultaneous ligature of both arteries was followed by recovery.

ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF CAROTID AND SUBCLAVIAN.

| OPERATOR. | SEX. | AGE. | CAROTID LIGATURED. | SUBCLAVIAN LIGATURED. | REMARKS. |
|---|---|---|---|---|---|
| 1. FEARN. | f. | 28. | Aug. 30th, 1836. | Aug. 2nd, 1838. | Died nearly four months after second operation from pleurisy. Sac of aneurism of innominate filled with dense organised coagulum; except a channel of the size of artery for the passage of the blood. |
| 2. WICKHAM. | m. | 55. | Sept. 25th, 1839. | Dec. 3rd, 1839. | Tumour diminished after ligature of carotid, and dyspnœa ceased for a time; but symptoms returning, subclavian was tied. Relief of symptoms ensued; but tumour increased, and patient died two and a half months after first bursting of sac. |
| 3. ROSSI. | ... | ... | Carotid and subclavian simultaneously. | | Death in six days. Occlusion of left carotid and right vertebral arteries; circulation of brain carried on by left vertebral only. |
| 4. MALGAIGNE | ... | ... | April 3rd, 1845. | Oct. 17th, 1845. | Died on the twenty-first day after the second operation. Carotid obliterated; subclavian still pervious. |
| 5. BICKERSTETH 1864. | m. | 34 | May 10th, 1864. | Seven weeks after ligature of carotid. | Marked improvement after ligature of carotid. That of subclavian very difficult, owing to close proximity of the sac. Died Sept. 20. |
| 6. C. HEATH. | f. | 32 | Subclavian and carotid simultaneously. Nov. 21st, 1865. | | Heath's patient lived a very intemperate life for four years after the operation, and died from the giving way of the aneurism in front of the sternum. The preparation in the museum of the College of Surgeons shows the aneurism to have been entirely aortic, springing from the right side of the ascending portion of the arch. There can be no doubt that the patient was benefited and her life prolonged by the operation, the disease being stationary for two years. |

### ANEURISMS OF INNOMINATE TREATED BY LIGATURE OF CAROTID AND SUBCLAVIAN—*continued.*

| OPERATOR. | SEX. | AGE. | CAROTID LIGATURED. | SUBCLAVIAN LIGATURED. | REMARKS. |
|---|---|---|---|---|---|
| 7. J. C. HUTCHISON. (Brooklyn.) | m. | 48 | Subclavian and carotid simultaneously. Jan. 16th, 1867. | | Death on forty-first day from suffocation dependent on tracheal obstruction. The aneurism involved the brachio-cephalic, the origins of the carotid and subclavian, and arch of aorta. |
| 8. MAUNDER. | m. | 37 | Subclavian and carotid simultaneously. Sept. 18th, 1867. | | Died on sixth day. Clot in aneurism extended into and choked the aorta. |
| 9. SANDS. | f. | 43 | Carotid and subclavian tied simultaneously. July 16, 1868. | | Six months after operation, aneurism not cured, though size and pulsation diminished. |
| 10. J. LANE. | f. | 45 | Carotid and subclavian tied simultaneously. Sept. 20, 1871. | | At first slight improvement, followed by rapid increase of aneurism. |
| 11. T. HOLMES. | m. | 45 | Carotid and subclavian simultaneously. Nov. 9, 1871. | | Death a few weeks after operation, galvano-puncture having previously been applied. |
| 12. MCCARTHY. | m. | 50 | Carotid and subclavian simultaneously. Oct., 1872. | | |
| 13. F. ENSOR. | m. | 50 | Carotid and subclavian simultaneously. Sept. 8, 1874. | | Recovery. Diminution in activity of aneurism. |
| 14. HOBART (of Cork) | f. | 25 | Simultaneous in 1839. | | First part of subclavian tied. Died of secondary hæmorrhage. Aneurism of the aorta. |
| 15. DURHAM. | ... | ... | Simultaneous. | | Died on eighth day of "shock." |

It was attempted in 1868 by Chevers, but the subclavian vein was wounded and the patient died in two hours ; and in another case Hodges performed the operation, but after death on the eleventh day no aneurism was found.

A *résumé* of the cases of aneurism of the innominate, in which the operation of ligaturing one or both arteries beyond the sac has been performed, having thus been given, the question arises whether these operations, or any of them, should retain a place in surgery. This question may be examined in two points of view : 1. As to the principle on which these operations are performed ; and 2, As to their results in practice. For the success of the distal operation, it is requisite that there be no branch given off, either from the sac or between it and the ligature; or that the current of blood through the sac be at least so far diminished as to admit of the deposition of laminated fibrine in sufficient quantity to fill it up, by a process similar to that which happens in a case of aneurism treated by the Hunterian method. In order that this may be accomplished, it is certainly necessary that the greater portion of the blood passing through the sac be arrested ; for, if the current that is still kept up be too free, the tumour will continue to increase, as we have seen happen in cases of inguinal aneurism in which the femoral artery has been ligatured below the epigastric and the circumflex ilii, the current through which has been sufficient to feed the sac in such a way that a cure could not be accomplished. If, therefore, but one of the vessels leading from the brachio-cephalic, as the subclavian beyond the scaleni, be tied, and but a third of the blood circulating through the main artery be arrested, are we justified in hoping that the circulation through the sac will be so influenced by the deprivation of this small quantity, that the remaining two-thirds of the blood, which will still pass through for the supply of the carotid and the branches of the subclavian, will gradually deposit those fibrinous laminæ by which obliteration of the tumour is to be effected? Should we not rather expect that the larger current will be too powerful to allow the formation of these layers, and will continue to distend the sac in such a way as to prevent its contraction? Surely, if the comparatively small and feeble streams of blood, that pass through the epigastric and circumflex ilii, are sufficient to interfere with the cure of an inguinal aneurism after the distal ligature of the femoral, the strong current that sweeps through the carotid and the large branches springing from the subclavian, with the full force derived from close proximity to the heart, will most probably be sufficient to prevent all lamination in an aneurism of the innominate. That the arrest of the circulation through one of these vessels only is not sufficient to influence materially the growth of the aneurism, is evident likewise from what is not unfrequently observed after death in cases of this kind—one or other of the vessels being found compressed and obliterated by the pressure of the sac, or plugged by fibrine, and yet no alteration in the tumour resulting. These cases, which are tolerably numerous, would of themselves have been sufficient to prove that something more than this amount of obstruction is required, in order to effect proper stratification of fibrine in the sac; and if we turn to the result of the twenty-eight cases in which either the carotid or the subclavian has been ligatured, we shall find that in one case only, that operated on by Evans of Belper, has a cure been effected; and in this instance how was it accomplished? According to the principle on which it was attempted to be established? Certainly not; but, as will be seen by attention to the details of the case, and as has already been pointed out with much acuteness by Guthrie, by the accidental setting up in the artery of inflammation, which extended to the sac, and thus obliterated it.

In the case (that of Mrs. Denmark) in which Wardrop tied the subclavian for the cure of aneurism of the brachio-cephalic, there is some reason to doubt whether the arrest of the progress of the tumour was owing to the ligature of the subclavian artery, or whether it was not much influenced by the obstruction which existed in the carotid for nine days after the operation, during which time so abundant a deposit of laminated fibrine might have occurred as to arrest the progress of the disease for some length of time. In this case, also, Guthrie supposes it probable that the inflammation of the tumour might have led to its obliteration.

From a careful consideration of all the circumstances of the cases in which ligature of one vessel only, either subclavian or carotid, has been employed for brachio-cephalic aneurism, we are, I think, fully justified in concluding that in sixteen of the cases the fatal result was accelerated, occurring as a consequence of the ligature of the vessel; in three the progress of the disease was not materially interfered with; in two it was arrested, the patients living for twenty months and two years respectively; and in one case only the disease was cured. The improvement in two of the cases was the result of accidental circumstances; which were unexpected, and unconnected in any way with the principles on which the operation was undertaken. These results would not, in my opinion, justify any Surgeon in again making an attempt to cure an innominate aneurism by the ligature of either the subclavian or the carotid artery alone, the patient having been directly killed by the operation in two-thirds of the cases. Of the remaining third, in one-half the patients recovered from the operation, but the disease ran its course as if no such procedure had been adopted; and in the remaining slender percentage of cases the improvement that took place in two, and the cure in the one solitary instance, were due to accidental circumstances unconnected with the operation, and which consequently might have developed themselves equally if none had been performed.

We have yet to consider the operation in which both arteries are ligatured. This double operation may either be performed with an interval between the application of the two ligatures, sufficient for the establishment of collateral circulation; or the two vessels may be ligatured simultaneously. The former plan has been adopted in four cases; the latter in eleven; not a sufficient number for any safe deduction. In one of the four cases in which an interval intervened between the two operations (Fearn's), the tumour seems to have undergone a cure, being filled with dense laminated fibrine: but the patient died eventually of pleurisy. In another case (Wickham's) no good results followed the operation, death occurring from bursting of the tumour. The third case (Malgaigne's) died from the second operation. The fourth case (Bickersteth's) also died. In the eleven cases in which both vessels were ligatured simultaneously, death occurred in one instance in consequence of the left carotid and right vertebral being accidentally occluded, and the cerebral circulation being then solely dependent on the left vertebral; in another (Hutchison's), from compression of the trachea and consequent suffocation; and in a third, from the aorta being diseased and plugged with clot. In two cases only (Heath's and Ensor's) was the operation followed by marked improvement, though not by cure of the aneurism, which in Heath's case proved to be aortic. In Hutchison's case there is reason to believe that the carotid only was tied, the ligature having been applied to the sheath of the subclavian instead of to that vessel itself, which, after death on the forty-first day, was found plugged by old coagulum, but without any sign of having been tied. In five of the remaining six, the patients died. As I have just said, these cases are not sufficiently numerous or free from modifying circumstances to enable us to draw any definite inference from them: we must therefore revert to the principle on which this operation should be undertaken. This will differ materially, according to whether the two arteries are ligatured simultaneously, or with a sufficient interval for the re-establishment of collateral circulation.

If an interval of two years, as in the first case, or even of two-and-a-half months, as in the second instance, be allowed to elapse between the ligature of the carotid and that of the subclavian, the operation reduces itself essentially to that of the ligature of a single artery, which, as has already been shown, is insufficient to induce those changes in the sac that are necessary for the accomplishment of a cure. If the patient survive the effect of the ligature of the carotid for a few weeks, sufficient time will have been afforded for the proximal end of the subclavian, the vertebral artery, and the thyroid axis to take upon themselves a great increase of development—the collateral circulation being carried on by them and not by the left carotid; so that, by the time that the subclavian comes to be ligatured beyond the scaleni, the sac will still continue to be traversed by a current of blood for the supply of the branches of the subclavian, dilated beyond their normal size, in consequence of the task of supplying the right side of the neck, face, head, and brain being principally thrown upon them. This current through the proximal end of the subclavian, increased as it will have been by the whole of that blood which is destined to supply the place of that which should pass by the carotid, will place the sac in nearly the same condition as it was before the ligature; and will consequently, for the reason that has already been given, be too powerful for a cure to take place in the course of its stream.

It now remains for us only to consider the *simultaneous* ligature of both vessels—an operation that has been performed eleven times. In reasoning upon the simultaneous ligature of the two vessels, we must consider two points: 1. In what condition do we place the sac? 2. Is the danger of the patient much increased?

So far as the *sac* is concerned, it is impossible to place it in a better condition for the deposit of fibrinous matter; two-thirds of the blood flowing through it being arrested, and that only traversing it which is destined for the supply of the branches of the subclavian. It is by no means improbable that even this stream may yet be too large and forcible to allow the process of occlusion to take place, yet it is impossible still further to diminish it; and if the aneurism be sacculated, and project from one side of the innominate artery, particularly to its internal or mesial aspect, it is by no means impossible that it may be sufficiently removed from the stream to allow consolidation of its contents.

Does it add to the danger of the patient to ligature these two vessels simultaneously rather than separately? I think not. If the risk of a double operation is to be incurred, I cannot think that it would be positively increased by the two being performed at once, instead of at separate intervals; the whole of the vessels that serve to maintain the collateral circulation in the head and upper extremity—the vertebral, inferior thyroid, suprascapular, posterior scapular, and cervical—being left without interference. And the result that has followed the limited number of these operations corroborates the justice of this opinion, for we find that the patients recovered from the operations in seven out of the eleven cases.

But the result of these seven cases, so far as the aneurism itself was concerned, was by no means satisfactory. In Heath's case, although the patient survived the operations for four years, yet the disease proved at the *post mortem* examination to have been an aneurism of the arch of the aorta, and not of the innominate; Ensor's case is still incomplete, the operation having been performed late in 1874; whilst the report in Sands' case, within six months after the operation, shows that the aneurism was then not closed, although smaller and less active. In Hutchison's case, the aneurism involved all the neighbouring arteries. In Maunder's, it appears to have been aortic as well as brachio-cephalic; and in Lane's and Holmes' cases no benefit appears to be attributable to the operation. So far, then, as actual results go, it is evident that but very little, if any, benefit has been derived from this operation in the great majority of the cases in which it has been done. The patients would probably have had an equally good, if not a better, prospect of life, if treated by palliative and constitutional means; for it must not be forgotten that patients with aneurism of the innominate have been cured by such means, which cannot be said of the operation. Added to all these considerations, there is extreme difficulty in the diagnosis, not only of the exact extent of an innominate aneurism, whether it implicate the aortic arch or not, but whether it be an aneurism of the arch or of the brachio-cephalic. And I confess that I do not think that, however strong *a priori* reasoning may be in favour of this operation, the results hitherto obtained have been such as to encourage a repetition of it.

## ANEURISM OF THE CAROTID ARTERY.

**Aneurismal Varix of the Carotid Artery and of the Jugular Vein,** as the result of punctures and stabs in the neck, has been met with in a sufficient number of instances to establish the signs and treatment of such a condition; and an instance is related by Mackmurdo, in which a communication was established between these vessels as the result of disease; but I am not acquainted with any case of *Varicose Aneurism* of these vessels having been recorded. The *Signs* of aneurismal varix in this situation present nothing peculiar; and the *Treatment* must be entirely of a hygienic character, no operative interference being likely to be attended by any but a fatal result. It is the more desirable not to interfere in these cases, as the disease does not appear to shorten life.

**Spontaneous Aneurism of the Carotid** is not of very unfrequent occurrence: in Crisp's table of 551 aneurisms, 25 were of the carotid; and it ranks in order of frequency between those of the abdominal aorta and of the subclavian. It occurs more frequently in the female than any other external aneurism; thus, of the 25 cases alluded to, 12 were in women, owing probably to its seldom being the result of violence, but generally arising from disease of the coats of the vessel. In Holmes' table of 337 aneurisms, 11 were of the common carotid, 10 being spontaneous, and 1 traumatic. Three of the former were in women. This aneurism is also remarkable as occurring at earlier ages than most others: thus, Hodgson has seen it in a girl of ten; and Sykes, of Philadelphia, in one of eighteen. The right carotid is much more commonly affected than the left, and the upper portion of the vessel than the lower; indeed, the bifurcation is the most common seat of aneurismal dilatation. The root of the right carotid not uncommonly is dilated; but I have never seen or heard of a case in which the left carotid, before emerging from the chest, has been affected.

SYMPTOMS.—A carotid aneurism in the early stage presents itself as a small, ovoid, smooth tumour, with distinct pulsation and bruit, and a well-circumscribed outline. It is commonly soft and compressible, diminishing in size on pressure, and expanding again with the usual aneurismal dilatation. As it increases in size, it becomes more solid, occasions shooting pains in the head and neck, and, by its pressure on the pharynx, œsophagus, and larynx, produces difficulty in deglutition and respiration: sometimes the salivary glands are much irritated. After a time, the cerebral circulation becomes interfered with, giving rise to giddiness, impaired vision of the corresponding eye, noises in the ear, and a tendency to stupor. These symptoms may each be owing to compression of the jugular, or to difficulty in the transmission of the blood through the tumour. The size that these aneurisms may attain varies greatly: usually they are confined to the space under the angle of the jaw, but not unfrequently they may occupy the greater part of the side of the neck. If they be allowed to increase without interference, death may happen, either by rupture externally, or into the pharynx or œsophagus; by asphyxia, from pressure on the larynx or recurrent nerve; or by starvation from compression of the œsophagus.

Aneurisms of the carotid are usually of slow growth, and may sometimes exist for a considerable number of years without giving rise to any special inconvenience: this is more particularly the case when they are seated at the bifurcation of the artery; when at the root, they are more likely to be attended by injurious pressure-effects.

Diagnosis.—The diagnosis of carotid aneurism is without doubt more difficult than that of any other form of external aneurism: the best proof that it is so, may be found in the fact that, of the cases in which the carotid artery has been ligatured for supposed aneurism of it or its branches, in several instances no such disease existed—solid cysts, or other tumours of the neck having been mistaken for aneurism, and this by Surgeons of great and acknowledged repute.

The diagnosis of aneurism of the lower part of the carotid from *similar disease of other arteries* at the root of the neck, as of the subclavian, vertebral, and brachio-cephalic, and the arch of the aorta, is surrounded by difficulties, which can only be cleared up by a careful stethoscopic examination of the part. In some aneurisms of the arch of the aorta, the sac rises up into the neck, so as closely to simulate a carotid aneurism, as in the annexed cut (Fig. 379); and this greatly increases the difficulty of the diagnosis. In such cases, Holmes suggests that the effect produced by carefully applied distal pressure may aid in the diagnosis. If, after a few hours, when the collateral circulation should be commencing to enlarge, the sac shows no signs of diminished tension, the case is very probably one of aortic aneurism. The principal affections of the neck, however, with which aneurism of the carotid may be confounded, are varix of the internal jugular vein, enlarged lymphatic glands, abscess, tumours, cysts in the neck, and pulsating bronchocele.

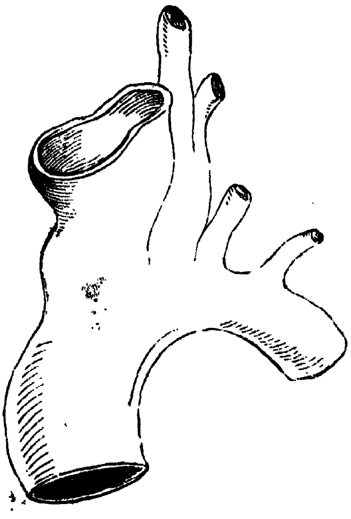


Fig. 379.—Aneurism of the Summit of the Arch of the Aorta, simulating Carotid Aneurism.

A *dilated artery doubled upon itself* may closely resemble an aneurism when situated at the root of the neck. Such a case is recorded by Coulson. It occurred in an old woman of 88. No treatment was adopted, and after death the supposed aneurism was found to be a reduplication of the common carotid surrounded by indurated cellular tissue.

From *varix* the diagnosis may readily be made by attention to the following circumstances: that in varix the tumour is always soft, does not pulsate expansively, and diminishes in size during a deep inspiration, and on compressing the vein on its distal side.

*Glandular tumours of the neck* are often very difficult to distinguish from aneurism, more particularly when the artery passes through and is embraced by the tumour, so that the whole mass distinctly moves at each pulsation. In these cases also there may be an apparent diminution in the size of the tumour on compression, by the artery within it being emptied, or by the growth receding into some of the areolar interspaces of the neck. But in the great majority of instances, attention to the globular, oval, and nodulated feel of grandular swellings, the possibility of raising them up and pushing them away from the vessel, which may best be done by feeling the carotid with the ends of the fingers of one hand, and then pressing upon the tumour with the other, will clear up the true nature of the case.

From *abscess of the neck* the diagnosis must be made on general principles. The coëxistence of ill-defined hardness and of enlargement of the glands, of an inflamed state of the skin, the ready detection of fluctuation, and the absence of expansive pulsation in the tumour, will show that it is not aneurismal, however similar its other characters may be. It is also of importance to observe that an aneurism that fluctuates is always forcibly distended with strong pulsation, and can be materially diminished by pressure, neither of which circumstances can possibly occur in abscess. But if abscess may be mistaken for aneurism, the converse also holds good; and an aneurism may, unless care be taken, be mistaken for abscess—a far more fatal error. And there is one variety of false aneurism, that to which Liston has invited special attention, against which the Surgeon must be carefully on his guard, on account of the many points of resemblance between it and aneurism: I mean the case in which an artery has given way into the sac of an abscess. In this case, fluctuation and pulsation will exist, although not perhaps of a distending kind. An important diagnostic mark will be, however, that the outline of an aneurism is distinctly defined and limited, while that of an abscess never is. Aneurism of the internal carotid has been found by Syme to simulate very closely *abscess of the tonsils.*

*Tumours* of various kinds—carcinomatous, fatty, and fibrous—may occur in the neck, and cause some little embarrassment in the diagnosis from aneurism; thus Lisfranc, O'Reilly, and Kerr of Aberdeen have recorded cases in which the artery has been ligatured in such cases by mistake for aneurism. The diagnosis of such tumours as these must be effected on ordinary principles. I have in several instances met with a small, hard, distinctly circumscribed tumour, lying directly upon the carotid artery, and apparently connected with it and receiving pulsation from it, usually produced by a fit of coughing or laughing. This tumour, with the true nature of which I am unacquainted, remains stationary, and does not require any operative interference.

The thyroid body is not unfrequently the seat of enlargements, that may be and have been mistaken for aneurism. These consist chiefly in a circumscribed enlargement of one lobe of the gland, which extends laterally over the common carotid, and receives pulsation from it. This kind of bronchocele may be diagnosed from aneurism by the communicated pulsation in it ceasing when it is raised from the artery. The most puzzling cases, however, and those in which mistakes may most easily be made, are instances of *pulsating bronchocele,* in which these tumours have an active and independent pulsation or thrill. In these instances, however, there are three points that will almost invariably enable the Surgeon to effect the diagnosis. Thus the tumour, although principally confined to one lateral lobe, always affects the isthmus more or less. Then again, in bronchocele, that portion of the tumour is most firmly fixed which stretches towards the mesial line; whilst in carotid aneurism the firmest attachment is under the sterno-mastoid muscle. The third point of difference is that, on desiring the patient to make an effort at deglutition, the enlarged thyroid body moves with the larynx and trachea. *Cysts in the thyroid body* are of more common occurrence than pulsating bronchoceles, and sometimes equally difficult of diagnosis. Dupuytren has pointed out that, when these cysts are tapped, the pulsation often becomes stronger, and the fluid, which on first flowing is serous, may at last become pure arterial blood, so that the Surgeon may suspect that he has punctured an aneurism.

TREATMENT.—**Digital Compression** has of late years been successfully employed for the treatment of carotid aneurism. A case of aneurism of the common carotid artery, cured by intermittent digital compression, has been recorded by Rouge of Lausanne. The patient was a male, aged 68. Compression was made by placing the thumb against the anterior edge of the sterno-mastoid and the next three fingers under the posterior edge of the muscle; the artery was thus seized and compressed. This avoided any pressure on the pneumogastric nerve, which was supposed to be the cause of the pain usually caused by attempts to compress the carotid. The compression was applied for seventeen days during seven or eight hours each day; and at the end of the time the man was cured. In addition to this, Holmes has collected four successful cases by Sheppard, Kerr, Humphry, and Gay, and two unsuccessful by De Castro and Delore. The pressure should, if possible, be applied above the transverse process of the sixth cervical vertebra, so as to avoid compressing the vertebral artery at the same time.

**Ligature.**—Since the time when Sir A. Cooper first ligatured the carotid, in 1805, the means on which the Surgeon almost always relies for the cure of aneurism of this vessel is deligation of the artery at a distance from the sac.

When the aneurism is so situated that a sufficient extent of healthy vessel exists between the sternum and the base of the tumour to admit of the application of a ligature, the Hunterian operation may be practised. If, however, the root or lower portion of the artery be so involved that there is no room to apply the ligature between the heart and the seat of the disease, the distal operation may be performed.

**Ligature of the Carotid.**—When the Surgeon can choose the seat at which to ligature the artery, he usually selects the part of the vessel which bisects the angle formed by the anterior edge of the sterno-mastoid with the omo-hyoid muscle. The course of the artery is marked by a line drawn from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. The artery is reached by making an incision, about three inches in length, over this course upon the anterior edge of the sterno-mastoid, which is the directing line and a sure guide to the artery. After dividing the integument, the platysma, the subcutaneous fascia, and areolar tissue, and turning outwards the edge of the sterno-mastoid, the sheath of the vessel is exposed. This must then be carefully opened towards its inner side over the artery and not over the vein, any branches of the descendens noni nerve being avoided. After opening the layer of cervical fascia common to both vessels and the pneumogastric nerve, the special sheath of the artery must be carefully opened until the external coat is seen. The needle is then passed between this sheath and the external coat through the loose areolar tissue naturally found in this situation. If this be carefully done it is almost impossible to wound the vein or pick up the nerve. If, however, the true sheath of the artery be not opened either of these accidents may happen. The needle must be passed from without inwards, between the vein and artery (Fig. 380). In performing this operation, subcutaneous vessels are occasionally wounded, which may bleed rather freely ; if so, they should be ligatured. When the sheath is opened, the jugular vein sometimes swells up considerably, so as to obscure the artery, but by being drawn aside with a retractor, or repressed by the assistant's finger, all difficulty from this source will cease. The pneumogastric nerve is not seen, as it lies deeply behind the vessels, and is drawn aside with the vein. If the aneurism have attained a very considerable size, extending low in the neck, and not leaving, perhaps, more than one inch of clear space above the clavicle for the Surgeon to operate in, the difficulties are necessarily very greatly increased ; and here the best plan will be to divide the tendon of the sterno-mastoid muscle, so as to give additional space. The

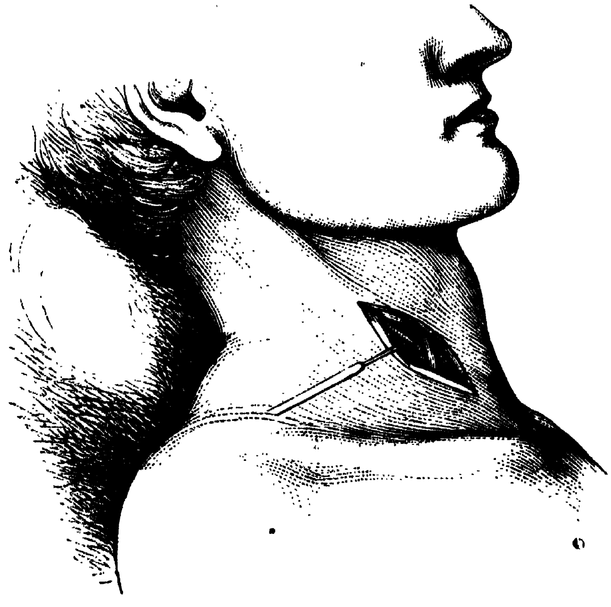


Fig. 380.—Incision for Ligature of the Carotid Artery.

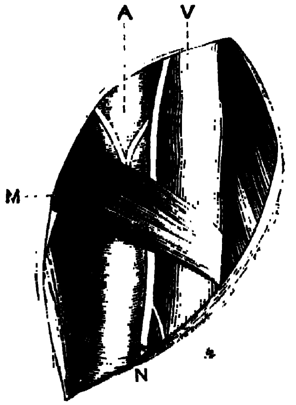


Fig. 381. - Diagram of Left Common Carotid Artery as seat of ligature. Sterno-mastoid much drawn aside. Sheath opened.

A. Common Carotid.
V. Internal Jugular Vein.
N. Pneumo-gastric Nerve, with branches of descendens noni.
M. Omohyoid muscle.

external portions of the sterno-hyoid and sterno-thyroid muscles may likewise be cut across for the same purpose. The jugular vein in this situation lies considerably to the outside of the artery (Fig. 381).

After ligature of the carotid artery, the blood is so freely conveyed to the distal side of the vessel, by the free communication subsisting between the arteries of opposite sides within the cranium, that a continuance and return of pulsation in the sac is of common occurrence. This condition, however, usually disappears after a time by the gradual consolidation of the tumour, and indeed may generally be looked upon as a favourable sign; being very seldom associated with those cerebral symptoms that, as will immediately be explained, commonly prove fatal after this operation. It is interesting to observe that the collateral supply, after the ligature of the common carotid, is not afforded by any of the branches of the corresponding vessel of the opposite side, but by the subclavian artery of the same side. In a case related by Porter, in which the right carotid had been tied, the subclavian and vertebral arteries on the same side were enlarged to at least double their natural diameters, and the chief communications outside the skull took place between the superior and inferior thyroid arteries, which were enlarged; whilst inside the cranium the vertebral took the place of the internal carotid.

*Suppuration of the sac* is not of very uncommon occurrence after the ligature of the carotid for aneurism—sometimes even after so considerable an interval as eight months, as happened in a case related by Post. In the majority of these instances, the patient eventually does well; but death may result by the tumour pressing upon the pharynx and larynx, or by the occurrence of secondary hæmorrhage, which may take place either from the part to which the ligature has been applied, or from the suppurating sac. In the first instance, it usually occurs about the period of the separation of the ligature; in the second, it may happen at a considerably later period, even after many weeks. As the suppuration is often due in all probability to the proximity of the wound and the ligature to the aneurism, it has been suggested that, in such cases, it might be safer to anticipate it by laying open the sac after the application of the ligature on the proximal side, and tying the vessel again on the distal side, thus performing a combination of Anel's and the old operation. It would appear, however, as if this were only substituting, with certainty, one evil for another that may very possibly be avoided. Besides these, which may be looked upon as the ordinary accidents following the application of a ligature for aneurism, deligation of the carotid artery occasionally gives rise to serious and even fatal disturbance of the circulation within the cranium.

**Effects on the Brain of Ligature of one or both Carotids.**—Many experiments have been made by Meyer, Jobert, and others, upon the lower animals, with the view of determining the effect produced on the brain by the ligature of the carotid arteries. But the deductions from these are of no value whatever when applied to the human subject, for the simple reason which appears to have been strangely overlooked), that in many of the lower animals on which the observations were made, as the dog and rabbit, for instance, the common carotid arteries are of secondary importance so far as the cerebral circulation is concerned, being destined principally for the supply of the external parts of the head—the brain deriving its chief supply from the vertebrals; whilst in other animals, as the horse, the brain derives nearly the whole of its blood from the carotids, and but a very small quantity from the vertebrals. Hence, in one case the carotids may be ligatured without danger, whilst in the other their deligation is inevitably fatal. The statistics of ligature of the carotid in the human subject have been collected by Norris, Ehrmann, and others; and more recently by Pilz of Breslau (*Archiv für Klinische Chirurgie*, 1868), who has collected 600 cases of the operation, including 27 in which the artery was tied on both sides. The causes which led to the operation were, hæmorrhage, in 228 cases; aneurism, in 87; erectile and other tumours, 142; extirpation of tumours, 71; cerebral affections (epilepsy, &c.), 34; and in 38 instances the distal operation was performed for aneurisms of the aorta and innominate artery. In the 228 cases of ligature for hæmorrhage, the presence of cerebral symptoms is noted in 69 out of 167 —no information being given in regard to 61; and, in these 69 cases, death took place in 40. Excluding, however, these from calculation, inasmuch as the brain-disorder may have been in many due to the hæmorrhage rather than to the operation, we derive from Pilz's statistics the following table showing the proportionate frequency of the occurrence of cerebral disease and of deaths from this cause.

TABLE OF LIGATURE OF CAROTID FOLLOWED BY CEREBRAL DISEASE.

| CAUSE OF OPERATION. | NUMBER OF CASES. | CASES IN WHICH CEREBRAL AFFECTION ENSUED. | DEATHS FROM CEREBRAL DISEASE. | DEATHS FROM ALL CAUSES. | NO RECORD REGARDING CEREBRAL SYMPTOMS. |
|---|---|---|---|---|---|
| Aneurism . . . . | 87 | 32 | 16 | 31 | 5 |
| Erectile and other Tumours . | 142 | 32 | 20 | 49 | 3 |
| Extirpation of Tumours . . | 71 | 13 | 8 | 25 | 8 |
| Cerebral Affections . . | 34 | 8 | ... | 1 | 3 |
| Distal Operation . . . | 38 | 11 | 7 | 25 | 0 |
|  | 372 | 96 | 51 | 131 | 19 |

By this it will be seen that the most common cause of death after ligature of the carotid is cerebral disease induced by the operation (as was, I believe, first pointed out by Chevers): and this result appears to have been relatively more frequent after the distal than after the Hunterian operation. If to these cases we add 14 in which the brachio-cephalic artery was ligatured, we get a total of 386 cases, of which 96 were attended by cerebral symptoms; or, as nearly as possible, 25 per cent.

We should necessarily expect that, in those cases in which both vessels had been ligatured, there would be a greater tendency to cerebral disturbance than in those in which only one had been deligated. It would however appear, as is shown by the following table, that of twenty-seven instances in which the double operation has been performed, death is recorded to have happened but in two cases from this cause; while in another, in which convulsions took place, a fatal result did not occur, and three other cases were attended by mere temporary disturbance of vision. In the only case (that of Mott, No. 16) where both carotids were ligatured simultaneously, with an interval of only a few minutes between the operations, coma and death resulted.

### CASES OF LIGATURE OF BOTH CAROTIDS.

| OPERATOR. | AGE. | DISEASE. | DATES OF LIGATURE. | RESULTS. |
|---|---|---|---|---|
| 1. Dupuytren and Robert. | ... | Aneurism by anastomosis of scalp. | Right carotid tied by Dupuytren in 1819; left by Robert for extension of disease, in 1857. | Delirium, hemiplegia of left side, and death. |
| 2. Macgill. | ... | Fungous tumour of both orbits. | Interval of a month. | Recovered. |
| 3. Ullman. | 20 | Erectile tumour of orbit. | Left tied first, 1823; right one year afterwards. | Death on third day by hæmorrhage. |
| 4. Mussey. | 20 | Aneurism by anastomosis of scalp. | Left carotid, Sept. 20; right carotid, Oct. 2, 1827. | Recovered. |
| 5. Müller. | 4½ | Erectile tumour. | Sept. 13, 1831, and Jan. 28, 1832. | Recovered. |
| 6. Preston. | 50 | Epilepsy; Hemiplegia. | Right carotid tied Aug. 23; left carotid, Nov. 14, 1831. | Recovered. |
| 7. Preston. | 24 | Partial paralysis and headache. | Right carotid, Sept. 7; left, Oct. 10, 1831. | Recovered. |
| 8. Preston. | ... | Epilepsy. | Tied at interval of month. | Recovered. |
| 9. Kuhl. | 53 | Aneurism by anastomosis of scalp. | Left carotid, May 24, 1834; right on Aug. 4, same year. | Recovered: convulsions after each operation. |
| 10. F. H. Hamilton. | 18 | Epilepsy. | Right carotid, Aug., 1838; left, March, 1839. | Recovered. |
| 11. Velpeau. | 29 | Aneurism by anastomosis of both orbits. | Right carotid first, August, 1839: left, about three months afterwards. | Recovered. |
| 12. Pirogoff. | 20 | Hæmorrhage from aneurism by anastomosis of scalp. | Left carotid, Jan. 16, 1843; right, Jan. 9, 1844. | Headache and vomiting after each operation: recovery. |
| 13. Ellis. | 21 | Secondary hæmorrhage following gunshot wound of tongue. | Interval of four-and-a-half days. | Cured. |
| 14. J. M. Warren. | 23 | Erectile tumour of face. | Tied left, October 5; right, Nov. 7, 1845. | Cured. |
| 15. Robert. | ... | Aneurism by anastomosis of forehead. | Left on June 5, 1846; right on Feb. 22, 1847. | Headache: temporary disturbance of vision: recovery. |
| 16. Mott. | ... | Carcinoma of parotid. | Interval of fifteen minutes. | Coma, and death in 24 hours. |
| 17. Mott. (Second case) | ... | Epilepsy. | Interval of half a year. | Recovered. |
| 18. Blackman. | 15 | Fungus of nasal fossæ. | Right first; left, three weeks later. | Temporary loss of vision of left eye: recovery. |
| 19. Mussey. | 19 | Erectile tumours. | Left first; right, one month after. | Temporary derangement of vision: recovery. |
| 20. Reynolds and Van Buren | ... | Aneurism by anastomosis. | Right carotid tied by Reynolds in 1844; left by Van Buren in 1850. | Recovery. |
| 21. Parker. | 45 | Carcinoma of antrum. | Interval of thirty-two days. | Death. |
| 22. Wood. | 53 | Encephaloid of antrum. | Right carotid, July 18; left, Dec. 26, 1856. | After second operation the tumour diminished: then diarrhœa, rigors, delirium, exhaustion, and death on sixtieth day. |

CASES OF LIGATURE OF BOTH CAROTIDS—(*continued*).

| OPERATOR. | AGE. | DISEASE. | DATES OF LIGATURE. | RESULTS. |
|---|---|---|---|---|
| 23. G. C. E. Weber. | 20 | Epilepsy. | Left carotid, Dec. 2; right, Dec. 19, 1857. | Recovered. |
| 24. Carnochan | ... | Large morbid growth of face (elephantiasis). | Right carotid tied, Nov., 1858; left, June, 1859. | Cured. |
| 25. Longmore | ... | Gun-shot wound. | Right, May 12, 1863; left, May 18. | Death in thirty-eight hours. |
| 26. Billroth. | 27 | Ulceration of carotid from syphilitic caries of petrous bone; Hæmorrhage. | Right carotid, Dec. 13; left, Dec. 26, 1864. | Return of hæmorrhage on sixteenth day: death from exhaustion: no cerebral symptoms. |
| 27. Buenger. | 34 | Aneurism by anastomosis and wound. | Left tied for the aneurism; five years afterwards the right, for a suicidal wound. | Disorganisation of right eye: recovery. |

After a careful examination of this subject, I think we are warranted in coming to the following conclusions. 1. Ligature of one carotid artery is followed by cerebral disturbance in more than one-fourth of the cases, above one-half of which are fatal. 2. When the two carotids are ligatured *with an interval of some days or weeks,* the operation is not more frequently followed by cerebral disturbance than when only one is tied. 3. Pathological investigation has shown that, if the vessels be gradually and successively obliterated, the patient may live, although one carotid and one of the vertebral arteries have been occluded by disease and the other carotid ligatured, as in a case related by Rossi. 4. As in a case recorded by Davy, an individual may even live for a considerable time, though both carotids and both vertebrals be occluded—the cerebral circulation being maintained through the medium of the anastomoses of the inferior and superior thyroids and the deep cervical with the occipital artery. 5. The reason why more or less extensive obstruction by disease of the arteries leading to the brain may, as appears from pathological records, be unattended by cerebral disturbance, while this so frequently follows ligature, lies (as has been pointed out by Pilz), that in the former case the obstruction is gradual, so that the collateral circulation has time to be established, while in the latter the interruption is sudden.

The *Cerebral Symptoms* that arise from the ligature of one or both carotids may be such as depend upon a diminished supply of blood sent to the brain; consisting of twitchings, tremblings or convulsive movements, syncope or giddiness, with paralysis, sometimes with complete hemiplegia of the side opposite to that of the ligatured vessel, troubled vision, and deafness. In other cases they appear to arise from increased pressure upon the brain—drowsiness, stupor, coma, and apoplexy supervening. To a third order of symptoms belong those that are of an inflammatory character, usually coming on a few hours after the operation.

The cause of these symptoms is certainly the disturbance of the cerebral circulation, induced by the ligature of the carotid. When a considerable portion of the supply of blood to the brain is suddenly cut off, two sets of symptoms may ensue—one *immediate,* the other *remote.* The immediate symptoms are those that generally result from functional disturbance of the brain, consequent upon too small a supply of arterial blood. They consist of syncope, trembling, twitches, giddiness, impairment of sight, and at last hemiplegia. After this condition has been maintained for a few days, the nutrition of the organ becomes materially affected, and softening of the cerebral substance takes place; giving rise to a new and more serious set of symptoms indicative of this pathological condition, such as convulsions, paralysis, and death. In other cases congestion may come on, either by the interference with the return of blood through the jugular vein, or as a consequence of that venous turgidity which we commonly observe after the ligature of a main arterial trunk; or perhaps coma may be induced by apoplectic effusion into a softened portion of the organ.

Inflammation of the brain may come on immediately after the application of the ligature, being apparently at once induced by the disturbance of the circulation. In other cases it occurs at a later period, as the result of alteration in the structure of the organ.

**Effects on the Lungs.**—Besides the brain, the lungs are not uncommonly secondarily affected after ligature of the carotid. To this condition special attention has been directed by Jobert and Miller. The lungs appear to become greatly congested, and have a tendency to run into a low form of inflammation. The cause of this congestive condition of the lungs is extremely interesting. It cannot be owing to the simple obstruction of the passage of the blood through the carotid causing a disturbance in the balance of the circulation, and thus a tendency to internal congestion; for, if this were the cause, we ought to meet with it generally after ligature of the arteries of the first class. Nor can it be owing to any injury sustained by the eighth nerve during the deligation of the artery; as in many of the instances in which it is stated to have occurred, there was no evidence of that nerve having been exposed or damaged, and every reason, from the known skill of the operators, to believe the contrary. I am rather inclined to look upon the unusually frequent occurrence of pulmonic congestion after ligature of the carotid, as a secondary condition consequent upon a derangement in the functions of the brain and medulla oblongata, primarily induced by the disturbed state of the circulation through that organ: for we know that any cause which depresses the activity of the nervous centres tends to diminish proportionately the freedom of the respiratory movements, and thus, by interfering with the due performance of the act of respiration, disposes to congestion of the lungs, just as we observe to happen in injuries of the head, in apoplexy, and in the operation of the sedative poisons. It would appear from the detail of some of the recorded cases, as well as from Jobert's experiment, that blood-letting is of considerable service in the removal of this condition, and should consequently not be omitted.

**Ligature of the Carotid on the Distal Side of the Sac.**—Aneurism of the carotid artery, occurring low in the neck, does not admit the application of a ligature on the cardiac side of the tumour. What, then, is to be done in such a case as this? Should it be left to the remote chance of a spontaneous cure, or should it be subjected to surgical interference? Spontaneous cure in carotid aneurism has never yet, I believe, been met with.

The Surgeon, therefore, must endeavour to treat the disease by ligature. Two plans of treatment are open to him—either to deligate the innominate artery, or to tie the carotid on the distal side of the tumour. The first alternative may fairly be set aside; for not only are the cases in which it is possible to find room between the sternum and the sac extremely rare, but, even were such an instance to present itself, few Surgeons would, I think, be justified in undertaking an operation which has only once succeeded, even (p. 110) in the most skilful hands; we are consequently reduced to the alternative of ligaturing the artery on the distal side of the sac. But although this operation is the only alternative that presents itself, yet its application in practice is attended by serious difficulties and perplexities; for the Surgeon must be able to satisfy himself that it is actually an aneurism of the root of the carotid with which he has to do, and that it is not the trunk of the innominate or the arch of the aorta that is affected. The difficulty in doing this is far greater than would at first appear; for, on examining the details of eight cases in which the distal operation has been performed for supposed carotid aneurism, three must be excluded; as, after death, the tumour was found to arise from the aortic arch. In the annexed table will be found the result of seven cases, in which the carotid artery has been tied for aneurism of its root on the distal side of the sac. I have excluded an eighth case, as there is reason to believe that in it the artery was not ligatured, but a portion of the sheath accidentally tied instead—an accident, by the way, which Sédillot has witnessed, which Norris states also to have occurred at the New York Hospital, and which I have known happen to a most excellent Surgeon in the case of ligature of the femoral artery.

ANEURISMS OF ROOT OF CAROTID TREATED BY LIGATURE ON DISTAL SIDE.

| OPERATOR. | SEX. | AGE. | RESULT. | CAUSE OF DEATH. | REMARKS. |
|---|---|---|---|---|---|
| 1. **Wardrop.** 1826. | f. | 63 | Recovered. | .. ... | Tumour diminished until fifth day: then inflamed, suppurated, and burst. The patient recovered, and was alive three years after operation. |
| 2. **Lambert.** 1827. | f. | 49 | Successful so far as aneurism was concerned. | Hæmorrhage from upper portion of artery. | Tumour diminished after operation, and became consolidated; sac filled with firm coagulum, and lower part of artery closed; ulceration into artery, just above part ligatured; vessel dilated where ligatured. |
| 3. **Bush.** 1827. | f. | 36 | Recovered. | ... ... | Suffocation was imminent before operation; tumour became rapidly diminished after ligature. Alive three weeks afterwards. |
| 4. **Montgomery.** 1829. | m. | 30 | Died. | Sac suppurated. | Aneurism of arch also. Left carotid tied. |
| 5. **Colton de Noyou.** 1840. | f. | 63 | Recovered. | ... .. | Tumour and pulsation diminished. Alive and well three years afterwards. |
| 6. **Demme.** | m. | 38 | Died. | Suppuration of sac: hæmorrhage. | Aneurism of arch: double aneurism of carotid. |
| 7. **Lane.** 1852. | m. | 36 | Died. 68th day. | Inflammation of lungs. | Tumour filled with layers of coagulum. Ulcerated opening communicating with apex of left lung. Left carotid tied. |

On analysing the cases in which the trunk of the common carotid has been ligatured on the distal side of an aneurism of the root of that vessel, there are several points of interest that arrest our attention. Thus we find that in every case the tumour, immediately on the ligature being tightened, underwent a considerable diminution in its bulk, with corrugation of the integuments covering it, and considerable subsidence in the force of its pulsations. In one case—that of Bush—respiration, which before the operation had been attended with great difficulty, became easy; and in two others inflammation of the sac took place; being in one (that of Wardrop) unattended by bad consequences, and in the other (Demme's case) followed by death. It is not safe to deduce any general conclusion from so small a number of cases; yet the result of these is so uniform, that I have no hesitation in stating it as my opinion that, whether we regard the principle on which this operation is founded, the amount of success which has hitherto attended it, the necessarily fatal result of these cases if left to themselves, or the absence of any other means that hold out a reasonable hope of benefit, the Surgeon is justified in resorting to the ligature of the trunk of the common carotid on the distal side of the sac, in cases of aneurism limited to the root of that vessel.

## ANEURISM OF THE INTERNAL CAROTID.

The Internal Carotid Artery may be the subject of aneurism before or after it has passed through the carotid canal and entered the cavity of the skull. The symptoms of these two classes of cases differ necessarily in almost every respect, as likewise do the termination and the susceptibility of the case to surgical interference.

**Extracranial Aneurism.**—When an aneurism affects the trunk of the internal carotid before its entrance into the skull, the symptoms presented by this disease do not materially differ from those of aneurism at the bifurcation, or of the upper part of the common carotid, except in one important respect, which was, I believe, first pointed out by Porter of Dublin—viz., tendency to the extension of the tumour inwards towards the pharynx, and to its protrusion into that cavity. The reason of this is obvious; when we consider the anatomical relations of the internal carotid artery, we at once see that its pharyngeal aspect is that which, if one may so term it, is the most superficial, and that between it and the surface the smallest amount of soft parts intervenes—nothing lying between the vessel and the mucous membrane except the thin paper-like constrictor, some lax areolar tissue, and a few filaments of the superior laryngeal nerve; whilst externally there are interposed between it and the integument the layers of the cervical fascia, the margin of the sterno-mastoid, the digastric and three styloid muscles, and the styloid process.

When dilatation, therefore, of the vessel takes place, it has a necessary tendency to push forwards that part of its covering where it meets with least resistance; and, this being to the pharyngeal side, more or less prominence will consequently be found in this cavity. In a case that occurred to Syme, this was especially well marked, the aneurism of the internal carotid simulating closely an abscess of the tonsil. In two cases related by Porter in the seventeenth volume of the *Dublin Journal of Medical Science*, this was one of the most marked features: the "appearances of the tumour (as seen by the mouth) were most alarming; the pulsation could be distinctly seen, and the blood almost felt under the mucous membrane; it seemed ready to give way and burst into the mouth every moment."

TREATMENT.—The treatment of these cases does not differ from that of aneurisms connected with the carotid arteries, and seated at the upper part of the neck; but we are not in possession of a sufficient number of facts to enable us to determine with any degree of precision what the result of surgical interference in them is likely to be. If we could give an opinion from the limited number of cases at present before the profession, we should feel disposed not to entertain a very favourable opinion of the result of the Hunterian operation, as applied to aneurism of the internal carotid outside the skull. This is doubtless owing to the situation of the aneurism against the mucous membrane of the mouth, being such that the surrounding tissues do not exercise a sufficient amount of pressure against the sac after the ligature of the vessel to allow the efficient deposition of lamellated coagulum, and consequent occlusion of the artery leading into it, which, in accordance with the principles that have been laid down in speaking of the Hunterian operation, are necessary to success.

## INTRACRANIAL ANEURISM.

Aneurisms within the skull may arise from any of the arteries that are met with in this situation, though some are much more liable than others to the occurrence of this disease. Of 62 cases noticed by Sir W. Gull, the basilar artery was the seat of disease in 20 cases, and the middle cerebral in 15. In 8 of the remaining cases, the internal carotid was affected as it lay by the sella Turcica; and in 6 others the anterior cerebral artery was the seat of aneurism. The vertebral arteries and their branches were affected in 28 cases, and the carotids and their branches in 34. The greater frequency of this disease in the basilar artery may probably be dependent on its large size, and the consequently greater impetus of the blood to it.

CAUSES.—The causes of intracranial aneurism are very obscure. It might be supposed that the comparatively small diameter of the arteries within the skull would render them little liable to the occurrence of spontaneous aneurism, were it not that the anatomical characters and physiological relations of these vessels predispose considerably to the occurrence of this affection; there being no other set of arteries in the body of the same size as these within the skull in which spontaneous aneurism so frequently occurs. This can only be accounted for by the thinness of their coats and want of an external cellular sheath rendering them unable to support the increased pressure from within, to which they are occasionally subjected in consequence of the alteration in pressure of the cerebral circulation at different periods, the result of some variation in the relative quantities of the different fluids within the skull, or of determination of blood to the brain. This would more particularly be the case if their natural elasticity had already been impaired by the occurrence of atheromatous or other degeneration of their coats. As these changes are the natural consequences of advance in age, we shall find the tendency to the occurrence of this disease increase with advancing years. Thus, according to Sir William Gull, of 58 cases in which the patient's age is given, only 12 cases occurred in persons under twenty-five, 5 of the patients being under twenty; of the remaining 46 cases, 13 occurred in persons under forty; of the remaining 33, 29 were met with between forty and sixty, and 4 in persons above sixty. Of the 58 cases, 35 were males, and 23 females. Church believes that, in the young, intracranial aneurism is due to embolism; partial obstruction and consequent dilatation of the artery leading to interference with its nutrition and degeneration of its coats.

The immediate exciting cause of the disease is most commonly involved in obscurity: sometimes it may be traced to a blow on the head, to a fall or concussion, or to excess in drinking; but more frequently the symptoms manifest themselves suddenly, without being in any way attributable to such external influences, and occur in vigorous and apparently healthy persons.

PATHOLOGY.—Intracranial aneurisms are almost always formed by the uniform dilatation of the whole of the calibre of the artery—the false or sacculated variety being rarely if ever met with: I am not acquainted with any instance of this. The coats of the arteries in this situation being very thin, and unprovided with any external cellular sheath that would support the impetus of the blood, rupture of the vessel would rather occur than partial dilatation, if one portion only of the circumference were diseased. Occasionally, though rarely, the dilatation is fusiform: when this does occur, it is probably confined to the basilar artery (Fig. 382).

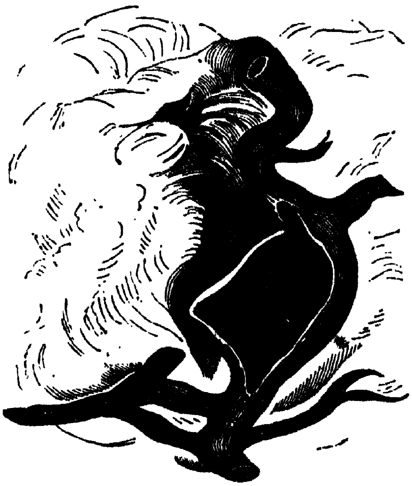


Fig. 382.—Fusiform Aneurism of Basilar Artery laid open.

The disease would appear to be of slow growth, and the sac sometimes becomes filled with laminated coagula so completely as to occlude the orifice of the artery from which it springs.

The size that aneurism in this situation attains before death results is sometimes considerable: thus, in a case of aneurism of the basilar artery, that occurred some years ago at the University College Hospital, the tumour was nearly as large as a walnut; in another case, in the same hospital, it somewhat exceeded this size. R. W. Smith, in the *Dublin Journal of Medical Science*, vol. xxv., mentions a case of multilocular aneurism of the left posterior cerebral artery as large as a small apple; and Serres, one as large as a hen's egg. On the other hand, they occasionally prove fatal by rupture before having reached more than a very small size—not larger than a pea or a nut.

It is seldom that more than one of the arteries of the brain suffer aneurismal dilatation. In the Museum of the College of Surgeons, however, are the preparations (Nos. 1687 and 1688) of aneurismal dilatation of both internal carotid arteries, resembling "two bulbs about five-eighths of an inch in diameter, filling up the hollow on each side the sella Turcica, which were evidently dilatations of the carotid arteries; and from their being filled with laminæ of coagulated blood, there could be little doubt of their being aneurisms of these arteries. The one on the left side was the largest; that on the right side communicated with the cavity of the artery, which was not the case with the other."

A case occurred in University College Hospital some years ago, under the care of A. T. Thomson, in which a somewhat similar condition existed. A man, forty-nine years of age, had fallen on his head some months before admission into the Hospital. Since then he had been garrulous, silly, and very irritable—becoming readily intoxicated. He suddenly became insensible and comatose, with vomiting and laborious breathing; he could close both eyes, but the right pupil was dilated; the left side was paralysed. He was treated for apoplexy, and became slightly better, but died in ten days from the first attack. On examination, an aneurism a little larger than a hazel-nut was found on the trunk of the right carotid, where it gave off the middle cerebral artery, and another small one on the course of that artery. There was a globular aneurism on the corresponding artery of the opposite side; the basilar artery was thickened, white, and opaque, as were also the other larger arteries of the brain; there was softening of both anterior cerebral lobes, especially the right one.

The arteries of the brain are very commonly healthy in these cases. Out of four instances of intracranial aneurism that have fallen under my observation, the other vessels of the brain have been healthy in three cases, and atheromatous in but one. In one case I have seen aneurism within the skull associated with aneurism elsewhere—in the thoracic aorta.

Pressure-Effects.—The pressure exercised by an aneurismal sac situated within the skull is always exclusively directed against the yielding cerebral substance, which is often extensively disorganised. The bones of the skull, however close their proximity to the sac may be, frequently escape, and seldom suffer much. This peculiarity in the effects of aneurism in this situation may be partly owing to the very dense and compact character of the inner layer of the skull, but is doubtless principally due to the very soft and yielding nature of the contents of the cavity. Absorption of the subjacent bone, however, sometimes takes place to a limited extent; thus in one case (Moore's) the body of the sphenoid bone was indented and partially absorbed.

The parts compressed in each case will vary according to the situation of the tumour. But those that principally suffer are necessarily those seated at the base of the brain, and forming the floor of the lateral ventricles. In Moore's case, one of the optic nerves was flattened by the pressure of the substance of the anterior lobe; the lamina perforata, the roots of the olfactory tract, the anterior part of the corpus striatum, and a considerable quantity of the neighbouring white matter of the anterior lobe, were removed. In a case by Lager, the portio dura of the right side was paralysed from this cause. In R. W. Smith's case, the floor of the third ventricle, the tuber cinereum, and the origins of the optic and olfactory nerves, suffered; the optic nerve of the opposite side was flattened and softened.

Besides the changes that take place in the cerebral substance as the result of pressure, important lesions may be met with as the effect of the interruption which the presence of the aneurism offers to the circulation in and nutrition of the cerebral hemispheres. Thus, in the case of aneurism of both internal carotids that has already been referred to as occurring at University College Hospital, there was white softening of both the anterior cerebral lobes; and this lesion was most marked on the side that corresponded to the largest aneurism, and where consequently, it may be supposed, the greatest amount of obstruction to the circulation existed.

SYMPTOMS.—The symptoms of aneurism within the skull are extremely equivocal; and, indeed, aneurism of large size may exist at the base of the brain without occasioning any symptoms whatever. An interesting instance of this occurred at University College Hospital in 1848. A man, thirty-seven years of age, died of pulmonary apoplexy and chronic pneumonia of the left lung, consequent upon the pressure of an aneurism of the commencement of the descending aorta on the pulmonary veins of that side. On examining the head after death, an aneurism of the basilar artery as large as a hazel-nut was met with, of which no suspicion had been entertained during life, there having been no head-symptoms whatever; the sac of the aneurism was very thin, and there was much atheromatous degeneration in the vertebral arteries.

The only symptoms that are of constant occurrence, when this disease goes on to a fatal termination, are those of hemiplegia and apoplexy. These may come on suddenly without any previous warning; or they may be preceded by a train of phenomena indicative of the existence of chronic disease within the cranial cavity.

The most constant of these phenomena is pain; which affects, however, great variety, both in extent and in character. It may be diffused, or may occupy a fixed point; it may be continuous or intermitting; it may be increased by movement, or accompanied by peculiar sensations, as of pulsation or of opening and shutting the top of the cranium.

The sight and hearing are often impaired. Dimness of sight, dilatation of one or both pupils, photophobia, diplopia, and loss of vision have been noticed in several of the cases recorded; ptosis has also been met with, from pressure on the third nerve by aneurism of the posterior communicating artery. Buzzing noises in the ears, and deafness, are also not uncommon symptoms; deafness, more particularly, appears to be a phenomenon of frequent occurrence.

The patient rarely loses the power of articulation and of deglutition; impairment of these functions, however, has been met with.

There may be paralysis of the side of the face, shaking palsy, or complete hemiplegia; or fits of an epileptic nature may occur. The mental condition may undergo changes indicative of chronic disease of the brain. There may be depression of spirits, listlessness, or, as was noticed in the case above related, the temper may become irritable, and the patient be garrulous or silly. Insanity has been noticed in one case. As is always the case in cerebral affections, the gastric functions are often impaired.

But very frequently no premonitory symptoms manifest themselves; the patient being suddenly seized when apparently in good health, with apoplexy, which terminates rapidly in death.

In some cases the presence of aneurism has been detected by a loud rough or "whizzing" noise being heard on the application of a stethoscope over one side of the head, and, perhaps, being audible to the patient. This sign, however, exists in but few cases; but when it does occur, it is unquestionably the most pathognomonic of all. I am not aware that it has been met with in any form of cerebral disease except intracranial aneurism.

Thus it will be seen by a reference to this list of symptoms that, with the exception of the whizzing noise, no special signs are afforded by aneurisms within the skull, which will enable us to distinguish between the symptoms occasioned by their presence and those of other tumours of the brain, and of organic cerebral disease.

CAUSES OF DEATH.—The fatal termination may occur from one of four causes.

1. The tumour may exercise such *pressure upon the whole cerebral mass* as to occasion death. This mode of termination is rare. I am acquainted with one case of this description, which is reported by Ruschenberger. The symptoms in this case were very remarkable, consisting of complete hemiplegia of the left side, with involuntary antero-posterior vibration of the head and body, and paralysis agitans of the right leg. The patient slept heavily, with loud snoring; he ate voraciously, but occasionally had considerable difficulty in deglutition and articulation; his intellect was clear, but very slow. After death, an aneurism of the basilar artery as large as a pigeon's egg, containing an irregular very hard dry clot of blood, was found pressing on the pons Varolii. The sac had given way at one point, extravasation taking place into the substance of the pons, which was softened, and of a bluish colour.

2. The most frequent mode in which death takes place in these cases is by the *sudden rupture of the sac* and extravasation of blood into the cavity of the arachnoid and the meshes of the pia mater at the base of the brain, or into the lateral ventricles—either from the aneurism projecting into them and there giving way, or rupturing into these cavities by breaking down the intervening cerebral substance (Figs. 383, 384). When this mode of termination occurs,

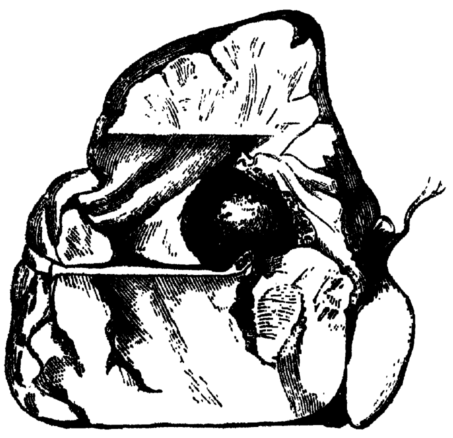


Fig. 383.—Aneurism of the Left Internal Carotid, bursting into Lateral Ventricle. View of Aneurism from above, projecting into Ventricle.

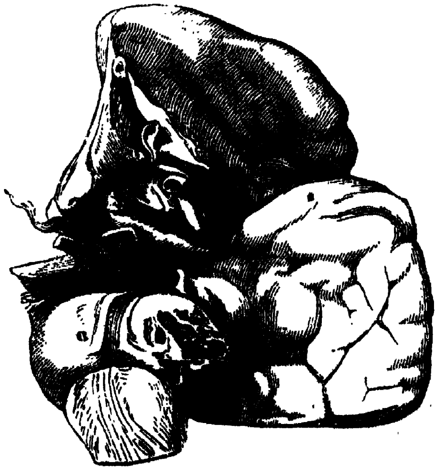


Fig. 384.—View of the same Aneurism from below, imbedded in substance of Hemisphere.

there are occasionally no warning nor premonitory symptoms of an impending danger; the patient, when apparently in good health, being struck down by an attack of apoplexy which is speedily fatal. More frequently a series of those symptoms that have already been mentioned as attending many cases of this disease, precede the fatal event for a longer or shorter time. When rupture of the sac and extravasation of blood take place, death is inevitable; at least, I am not acquainted with any case in which the appearance found after death converted me to the belief that the patient had even temporarily recovered from this condition.

Death from rupture of the sac appears to be most frequent in younger subjects. In the later period of life, aneurism is commonly associated with atheromatous disease of the vessels generally, which may cause death by softening and effusion of blood. According to Gull, of 20 cases occurring in persons under thirty-five years of age, 16 (or 80 per cent.) were fatal from rupture of the sac; while in 37 cases over thirty-five, death occurred from this cause in only 14, or 38 per cent.

3. Death may result from another cause than the pressure of the aneurismal sac or its rupture and the extravasation of its contents—viz., from *softening or disorganisation of the substance of the brain* to a greater or less extent, in consequence of the obstruction offered to the passage of the blood through the aneurismal vessel. In the case of aneurism of both carotids, already mentioned as having occurred at University College Hospital, this was the case; both anterior cerebral lobes were affected with white softening, and this condition was especially observable on that side on which the aneurism was largest.

4. Lastly, death may be produced by the mere *irritation* occasioned by the pressure of one or more aneurismal tumours within the cranium. Of this an interesting example is afforded by the history of a case of aneurism of both external carotids, contained in the Museum of the College of Surgeons, and related by Sir G. Blane in the *Transactions of the Society for the Improvement of Medical and Chirurgical Knowledge*, vol. ii. p. 192. In this case the patient, a lady aged 69, had suffered for four years from attacks of giddiness, headache, and imperfect vision; about sixteen months before her death she became insane, recovered, and then relapsed twice into the same state. After having regained her senses for some months, she became affected with giddiness, redness of the eyes, and violent maniacal delirium, which continuing for some weeks caused her death.

After death the following appearances were found. "Upon examining the body, there was no appearance in the brain itself that could in any way account for the symptoms. There was, indeed, a greater quantity of fluid than common in the ventricles, and the surface of it was moister than it is usually found in a sound state; but in all other cases which have occurred to me of organic affections of the brain proving fatal, except those which are sudden, such as apoplexy, there has been a preternatural quantity of fluid in its ventricles. There were also spicula of bone in the membrane forming the falx. The inner substance of the crura cerebri was of a brown colour, and more tender than natural. The optic nerves were smaller than natural, as if they had been wasted. The septum lucidum was more than usually dense.

"But the morbid appearance in this case, which was so singular, and to which the symptoms of complaint seemed chiefly referable, was two bulbs, about five-eighths of an inch in diameter, filling up the hollow on each side of the sella Turcica, which were evidently dilatations of the carotid arteries, and, from their being filled with laminæ of coagulated blood, there could be no doubt of their being aneurisms of these arteries. The dissection was made by Mr. Hunter, assisted by Mr. Home, in the presence of Dr. Jenner and myself, and all concurred in the opinion that these tumours were aneurisms. The one on the left side was the largest. That on the right side communicated with the cavity of the artery, which was not the case with the other."

Treatment.—In the treatment of intracranial aneurism there is usually little to be done, the nature of the case not being sufficiently obvious in the majority of instances to justify active measures. Should, however, the loud rough whiz be distinctly audible over one side of the head, more especially about the base of the skull, or by application of the stethoscope to the mastoid process, and should symptoms of cerebral compression begin to manifest themselves, ligature of the carotid artery on the affected side may with propriety be practised. This has been successfully done in a most interesting and instructive case of intracranial aneurism by Coe of Bristol ; and in one at University College Hospital, by Berkeley Hill.

### INTRAORBITAL ANEURISM.

Intraorbital Aneurisms were for a long time considered by Surgeons to be of the nature of erectile tumours ; but the error of this opinion has been pointed out by Busk, and more recently by Nunneley, who has conclusively shown that, except in those very rare cases in which a pulsating tumour of the orbit has been congenital, or has appeared shortly after birth, or has been associated with nævoid tissue developed in the eyelids, it must be looked upon as being a circumscribed aneurism. The vessel affected appears to be in some instances the ophthalmic artery itself; in other instances it would appear that the tumour is developed within the cranium, springing from the carotid artery, the ophthalmic being but secondarily affected. More recently Delens of Paris has recorded four cases verified by post mortem examination, in which the symptoms arose from an arterio-venous aneurism affecting the carotid artery in the cavernous sinus.

Causes.—The causes of intraorbital aneurism are in some cases very obscure ; in others, it evidently and directly has originated from a blow upon the head. In the first class of cases, where the disease has been of spontaneous and not of traumatic origin, the patient has suddenly felt a crack or snap in the orbit, like the "crack of a whip," or the "snap of a gun," and the disease has then developed itself gradually. In the other or traumatic cases, the blow upon the head has usually been severe, attended in some instances with symptoms of fracture of the anterior part of the base of the skull. It is a remarkable circumstance that, in all the spontaneous cases on record, the disease occurred in women, and with one exception (a case of Nunneley's), appeared on the left side. The circumscribed intraorbital aneurism has been met with at all ages in adults, even in persons of advanced periods of life.

Symptoms.—The first sensation experienced is, in spontaneous cases, that of a loud snap or crack in the orbit or head. This is followed by congestion of the conjunctiva, difficulty in opening the eyelids, a feeling of tension, and in some instances severe pain in and around the orbit. Loud whizzing bewildering noises are experienced in the head, and are much increased on stooping or lying down. In traumatic cases, a persistence of congestion of the conjunctiva with redness and some œdema of the eyelids, and the occurrence of noises in the head, are usually the first indications of the mischief that has occurred. In all cases, after a time, the eyeball becomes unduly prominent, and pulsation of a thrilling vibratory character can be felt in the orbit: on the application of the ear, a loud whizzing bruit is discernible, which extends widely over the side of the head. The eyeball itself eventually falls into a state of chronic congestion; chemosis occurs, the cornea becomes opalescent, the aqueous humour turbid, and sight is impaired or lost. The bruit and pulsation are diminished or cease on compressing the carotid artery of the side affected.

PROGNOSIS.—I think it is still doubtful what would happen in these cases, if the disease were left to itself without operation. It might be supposed that it would probably have a fatal termination; that the orbital plate would be perforated; that rupture of the aneurism would take place into the cranial cavity, and that sudden and immediate death would occur. But experience has shown that this is not necessarily so. I was consulted at the end of 1865 by a gentleman about 44 years of age, who, in consequence of a fall on the head a few months previously, had been attacked with symptoms of aneurism of the left orbit in the most marked manner. The bruit and the pulsation were very loud and distinct. The eyeball was greatly protruded, the conjunctiva and eyelids were congested and swollen. Greaves of Burton, with whom I saw the case, agreed with me in urging ligature of the carotid artery as the only means of cure. To this the patient would not consent, and preferred taking his chance. By attention to habits of life, abstinence from stimulants, and ordinary medical treatment, the tumour subsided, the eye retreated within the orbit, and the symptoms diminished greatly; so that, at the end of fourteen months from the time when I first saw him, I understand that they had to a very great extent disappeared.

But there is reason to believe that all the signs of intraorbital aneurism may entirely disappear, the disease undergoing a spontaneous cure. Collard relates the case of a man 41 years of age, who, in consequence of a fall on the back of his head by which he was rendered insensible, was gradually seized with symptoms of aneurism of the left orbit; bruit, pulsation, diplopia, and protrusion of the eyeball, together with congestion of the eyelids, being most marked. After the disease had continued for a considerable length of time, the patient was put upon a course of purgatives, with a calomel and belladonna pill daily, and cold lotions to the forehead. Under this treatment the symptoms gradually subsided, and in three years and a half from the commencement of the disease had entirely disappeared. Collard believes that in this case there was a dilatation of the ophthalmic artery and its branches, arising from and maintained by a morbid state of the ophthalmic ganglion, which furnishes vaso-motor filaments to the arteries of the eye. This ganglion he believes to have been injured by *contre-coup*, and to have remained in a state of hyperæsthesia, which produced dilatation of the walls of the ophthalmic artery and its branches, increase of the pulsations, and the other symptoms which have been described above.

PATHOLOGY.—The precise pathological change that takes place in inducing this remarkable disease is to a very considerable degree uncertain. The earlier observers supposed that an erectile tumour, an "aneurism by anastomosis," formed in the orbit. The fallacy of this opinion was pointed out by Busk, who referred the symptoms to a rupture of the ophthalmic artery and the development of a circumscribed traumatic aneurism of that vessel. More recently Nunneley has called in question the correctness of this view, and has referred the symptoms, in some of these cases, to a peculiar vascular condition of the parts, dependent more upon an affection of the veins than of the arteries, and somewhat analogous to what takes place in the exophthalmos of bronchocele; and in others, in which an aneurism really exists, he has pointed out that it is situated not in the orbit, but in the cranial cavity. In these latter cases, the prominence of the eyeball is due to distension of the veins of the orbit from obstruction to the return of blood; and the pulsation is communicated to these distended veins from the aneurism in the cavernous sinus. In one such case examined after death the aneurism was found to affect the carotid as it takes its last bend, and in another it was situated on the ophthalmic artery, just beside the sella Turcica, close to its origin from the internal carotid. Of the four cases collected by Delens, in which the symptoms undoubtedly arose from arterio-venous aneurism in the cavernous sinus, one was spontaneous, three arose from injury, one was from a direct wound from the point of an umbrella thrust into the opposite orbit, and two were from severe blows on the head, probably accompanied by fracture. Pathological anatomy has as yet thrown little light on the true nature of the disease. In one instance in which the patient died after the ligature of the common carotid artery in a case which presented all the phenomena of intraorbital aneurism in the most marked degree, and which was recognised as such by some of the most able oculists of the day, no trace of aneurism or of other vascular disease could be found on dissection. Is it possible that some derangement of the vaso-motor influence of the sympathetic may really occasion the symptoms of increased vascular activity that are so characteristic of this singular disease?

The secondary phenomena that are observed in these cases, such as congestion of the eyelids, of the palpebral and ocular conjunctivæ, amounting even to chemosis in many cases, and the muddiness of the aqueous humour and lens, are doubtless due to an interference with the return of blood from these parts through the ophthalmic vein, to the consequent congestion of the smaller vessels and to effusion of serum into the subconjunctival areolar tissue. The protrusion of the eyeball is due to the vascular tumour, whatever its precise nature may be, and the derangement in vision to an alteration in the axis of the eye consequent on this extrusion. It is remarkable that the *bruit* in these cases should be so loud, not only to the patient's own senses, but to the ear of the Surgeon; and this can only be accounted for by some acoustic exaggeration of the sound, dependent either on the thin and flaccid sides of the vessels through which the blood rushes, or on the proximity of the cranial bones, which may act as conductors of sound.

TREATMENT.—The results of the cases that have been referred to above, the uncertainty in which we are as to the real pathology of this disease, and the certainty that in some instances at least there is no true aneurismal tumour, would justify the Surgeon in having recourse to medical treatment, aided by digital compression of the carotid, and, perhaps, the application of ice to the forehead, before proceeding to operate. That these means are occasionally successful, there can be no doubt. Gioppi, of Padua, has recorded a case in which an intraorbital aneurism of great severity was cured by intermittent digital compression. The compression was kept up for periods of a minute or two with frequent intervals ; pressure continued for more than one minute caused fainting. It was cured in four days. Vanzetti and Scarramuzza have published another case, in which intermittent digital compression was kept up for five minutes at a time. The case was completely cured at the end of compression during seven hours and twenty minutes, spread over eighteen days. Should these means fail in producing a decided impression on the disease, then the only course left for the successful treatment of this formidable affection consists in the application of a ligature to the common carotid of the side affected. This operation has been highly successful. Out of 21 cases in which the operation has been performed, 15 have proved successful, there having been 3 deaths ; 2 were only partially successful, and in 1 the pulsation continued unabated by the operation. Of 14 cases in which it has been done in England, 13 have been cured. Examination of the body after death is recorded in 2 of the fatal cases. In one, there was softening of the left hemisphere of the brain, and the branches of the vertebral and carotid arteries were atheromatous. In the other—a case of traumatic aneurism—death occurred from hæmorrhage ; the carotid artery was healthy. The statistics collected by Delens, quoted by Holmes, are also remarkably favourable, for of 33 cases in which the carotid has been tied for this disease, only 5 died. In 22 the cure was complete, in 5 partial, and in 1 the operation failed. Galvanopuncture has been tried twice : once it failed, and once it was fatal. Coagulating injections have been used three times, twice with success. In a very interesting case which I saw in Velpeau's wards in 1839, both orbits were affected ; and, as pressure on the right carotid arrested the pulsation and bruit in both, that artery was tied. But though the disease was cured in the left orbit by this operation, and temporarily arrested in the right, it reappeared in the latter situation, and was eventually cured here by the ligature of the left carotid.

## ANEURISM OF THE SUBCLAVIAN ARTERY.

Aneurisms of the Subclavian occur in order of frequency between those of the carotid and of the brachio-cephalic arteries. They are most frequently met with on the right side, in the proportion of about three to one ; and this would appear to be in a great measure dependent on their being occasioned by direct violence, or by repeated or prolonged exertion of the arm ; thus they commonly occur from falls, blows upon the shoulder, or excessive fatigue of this extremity. From the fact of the aneurisms arising from external violence, we should expect to meet with them most frequently in males, and this we do in a remarkable manner. Of 120 cases collected by Poland, only 11 occurred in females, and in 4 of these instances the disease resulted from injury ; in 2 cases, both arteries were affected. The disease may be seated in any part of the vessel on the right side, though most commonly it is not dilated until after it has passed beyond the scaleni. On the left side aneurism never occurs before the artery has emerged from the thorax ; and then, as on the right, it most commonly happens in the third part of the course of the vessel. Subclavian aneurism may occur at any age above 21. It is most common in middle life ; and, according to Poland, is three times more frequent in England than in any other country.

SYMPTOMS.—An aneurism of the subclavian artery is characterised by a pulsating compressible tumour of an elongated or ovoid shape, situated at the base of the posterior inferior triangle of the neck, immediately above the clavicle. If it be small, it will disappear behind this bone on the shoulder being raised ; as it increases in size, it fills up the whole of the space between the clavicle and the trapezius, often attaining a very considerable bulk. In consequence of the pressure which it exercises on the brachial plexus of nerves there is pain, often attended by numbness, and extending down the arm and fingers, usually with some weakness of these parts. In some instances there is a spasmodic affection of the diaphragm, owing to irritation of the phrenic nerve. The external jugular vein is commonly distended and varicose, with œdema of the hand and arm, or even of the side of the body. The tumour does not increase rapidly in size, owing to its being tightly compressed by the surrounding parts ; and, as the disease never extends inwards, it does not interfere with the trachea or œsophagus. In some cases it has been known to extend downwards and backwards, so as to implicate the pleura and the summit of the lung.

DIAGNOSIS.—The diagnosis of subclavian aneurism is usually easy, and presents no point of a special character. Mayo, however, mentions a case in which an exostosis of the first rib pushed forward the subclavian artery in such a way as to cause it to simulate an aneurism, and eventually to arrest the pulsation in it.

RESULTS.—As a subclavian aneurism increases in size, it may become diffused, and burst either externally or into the pleural sac. A spontaneous cure has more frequently occurred in this than in any other external aneurism.

TREATMENT.—The treatment of subclavian aneurism is in the highest degree unsatisfactory. *Compression on the cardiac side* can only be employed when the artery is so irregularly distributed that it rises sufficiently high in the neck to admit of pressure being applied between the scalenus and the sac. Such a combination of irregular anatomical distributions with aneurism must of necessity be excessively rare. But in one case in which it occurred, Poland succeeded in effecting a cure by digital compression, kept up for ninety-six hours. The tumour then was smaller and harder, but still pulsated. The patient left the Hospital, and, at the end of a month, the tumour was found to have become solid, and to have ceased to pulsate. The number of cases in which compression is possible, may perhaps be increased by performing the operation under prolonged anæsthesia.

*Direct Pressure* on the sac has succeeded. It has been tried in three cases, and in all successfully. Warren of Boston made the pressure by means of a weight; and Corner of Poplar, by means of a leathern cup moulded to the swelling. The attempts at obtaining consolidation of the tumour by *constitutional means* or by *galvano-puncture,* have hitherto failed, except in some very rare instances. A case is reported by Yeatman of the cure of subclavian aneurism by Valsalva's plan in eighteen months. *Galvano-puncture* has been tried five times, but only once with success—in a case under the care of Abeille. Three cases have been successfully treated, two by Langenbeck of Berlin, and one by Dutoit of Bern, by the *subcutaneous injection of ergotin* into the integuments over the tumour. *Manipulation,* as recommended by Fergusson, has been tried five times (Holmes); once in the hands of Little successfully, once by Fergusson with partial success, and in the three remaining cases without any advantage. The treatment undoubtedly deserves a further trial in these cases, when we consider the extreme danger of the disease and the great want of success that attends other means of cure.

*Ligature of the brachio-cephalic, and of the subclavian itself,* before, between, and beyond the scaleni muscles, has been practised for the cure of this form of aneurism; it has likewise been proposed to apply the distal operation to the treatment of this disease, and to amputate at the shoulder-joint.

When an aneurism is situated on the right subclavian artery on the tracheal side of the scaleni, there is no way in which the flow of blood through it can be arrested, except by the ligature of the brachio-cephalic artery. When it is situated beyond the scaleni, or even between them, the ligature of the vessel has been practised in the first part of its course before it reaches these muscles. For subclavian aneurism on the left side, in these situations, no operation conducted on the Hunterian principle would be practicable.

Let us now proceed to examine the results that have attended these operative procedures.

**Ligature of the Brachio-Cephalic.**—The brachio-cephalic artery, as may be seen by the accompanying table (p. 110), has been ligatured fourteen times, and in every instance but one with a fatal result. In four other instances the operation has been commenced, but abandoned owing to unforeseen difficulties, and this by some of the most skilful operators that their respective countries can boast of.

Although, in reasoning on the propriety of performing an operation, it is not in general worth while to take into consideration the difficulties that a Surgeon may encounter, provided the operation be at last practicable; yet, when we consider the fact of the ligature of the brachio-cephalic having been attempted, and in consequence of unforeseen and insurmountable difficulties left unconcluded in so large a proportion as one-fourth of the cases, and these in the hands of Surgeons who were as well able as any to accomplish whatever was in the power of operative surgery to do, we may well hesitate upon the difficulties that beset the operation itself, before proceeding to the consideration of its results. The difficulties to which I allude do not consist merely in the position and anatomical relations of the vessel, but rather in the condition in which the artery and the adjacent structures may be found after the vessel is exposed. Thus, in Porter's case, the aneurism, which was a large one, occupied the whole of the inferior posterior triangle of the neck, being nearly six inches broad; as no pulsation was traceable in the vessels beyond the aneurism, it was useless to

## CASES OF LIGATURE OF BRACHIO-CEPHALIC ARTERY.*

| OPERATOR. | SEX. | AGE. | NATURE OF DISEASE. | RESULT. | REMARKS. |
|---|---|---|---|---|---|
| 1. MOTT. | m. | 57 | Subclavian aneurism. | Died on 26th day. | Tied an inch below bifurcation. Ligature separated in fourteen days. Hæmorrhage on 25th day, stopped by pressure: recurred on 26th. |
| 2. GRÄFE. | ... | ... | Subclavian aneurism. | Died on 67th day. | Ligature separated in fourteen days. Died of hæmorrhage. |
| 3. HALL. | ... | ... | Subclavian aneurism. | Died on 5th day. | Artery was diseased and gave way. Bleeding arrested by plug: death from other causes. |
| 4. DUPUYTREN. | ... | ... | ... ... | Died. | Case referred to as occurring in the practice of Dupuytren. |
| 5. NORMAN. | m. | ... | Subclavian aneurism. | Died. | Died of pericarditis sixty hours after operation. |
| 6. BLAND. | m. | 31 | Subclavian aneurism. | Died on 18th day. | Hæmorrhage came on on the 17th and 18th days. Ligature applied to upper portion of artery. |
| 7. LIZARS. | ... | ... | Subclavian aneurism. | Died on 21st day. | Ligature separated on 17th day. Hæmorrhage on 19th. |
| 8. HUTIN. | m. | 26 | Hæmorrhage from axilla after ligature of subclavian. | Died in 12 hours. | Punctured wound in axilla, for which subclavian was tied; secondary hæmorrhage, and then brachio-cephalic tied. |
| 9. ARNDT. | ... | ... | Subclavian aneurism. | Died on 8th day. | Inflammation of lung, pleura, and aneurismal sac. |
| 10. COOPER. (San Francisco.) | m. | ... | Subclavian and carotid aneurism. | Died on 9th day. | Upper end of sternum and inner end of clavicle removed. Dyspnœa and retention of urine: pus in the right kidney. |
| 11. COOPER. (Do.) | m. | ... | Subclavian and carotid aneurism. | Died on 34th day. | Bones removed as in previous case. Patient was apparently doing well, when secondary hæmorrhage appeared. Immediate cause of death, hæmorrhage, in consequence of removal of bandages by patient. |
| 12. GORE. (Bath.) | m. | 52 | Subclavian and axillary aneurism. | Died on 17th day. | Artery cut through by ligature. Carotid extremity not contracted, but partially plugged with dark coagulum. Inflammation of subclavian vein (left). Pus in anterior mediastinum. Aneurism contracted and filled with coagulum. |
| 13. SMYTH. (New Orleans.) | m. | 32 | Subclavian aneurism. | Recovery. | Ligature applied to brachio-cephalic a quarter of an inch below bifurcation, and at same time to carotid one inch above origin. Hæmorrhage on 15th, 33rd, and 51st days, arrested by pouring shot into the wound. Ligature of right vertebral on 54th day. Tumour returned ten years afterwards and proved fatal. |
| 14. BICKERSTETH. (Liverpool.) | m. | 40 | Subclavian aneurism. | Died on 6th day. | Direct compression tried on the artery for two days. Then ligature above and below the spot where compression had been applied. Death from hæmorrhage. |

N.B.—The artery was cut down upon, but not actually ligatured, by Porter, Post, Aston Key, and Hoffman.

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* These are all the cases of ligature of the brachio-cephalic artery the details of which I have been able to collect. This artery is also said to have been once ligatured by Pirogoff, and twice by Bugalski—all three cases fatal; but, as I can find no details of these operations, I have omitted them in the above table. Gurlt, in his Report on Surgery ("Archiv für Klinische Chirurgie," vol. iii., 1862), says, in speaking of Cooper's second case: "This is the *fifteenth* case of ligature of the innominate artery; and every one of them has proved fatal."

attempt ligature on the distal side. On exposing the brachio-cephalic, that vessel was found to be diseased, and it was not thought desirable to pass the ligature round it. In consequence of the exposure of the artery, however, the pulsation in the tumour gradually diminished, and at last ceased entirely, its bulk also becoming less.

In Key's case, in which it was impracticable to pass the ligature, it was found after death that the brachio-cephalic was diseased, being dilated immediately after its origin into an oblong tumour, which occupied the whole of the artery. It is remarkable that in this case, as in Porter's, inflammation seems to have taken place in the artery in consequence of the necessary handling to which it was subjected, and that the pulsation in the sac consequently diminished.

The difficulties of the operation are in themselves of serious magnitude; arising from the depth of the vessel, from its proximity to the centre of the circulation, and from the neighbourhood of large veins, which may become turgid, and a wound of which not only obscures the line of incision with venous blood, but induces a risk of the entrance of air into the circulation. But even when these have been surmounted, and the artery has been exposed, its coats may be found so diseased, or its calibre so increased, that it may be undesirable or impossible to pass a ligature round it. The failure in deligating the artery would, however, as we shall immediately see, appear to be less disastrous in its consequences than success in that attempt; for of the three cases that have just been referred to, in which this attempt was made and did not succeed, one was cured of the disease, the artery being obliterated by adhesive inflammation; and in another, Key's patient, an attempt to set up this action appears to have been made, the tumour becoming solid and ceasing to pulsate; whereas, in every case but one in which the vessel was ligatured, a fatal result speedily ensued.

The results of the ligature of the vessel are then in the highest degree discouraging; for of the fourteen cases in the table in which it has been done, only one has recovered. The only successful case, that in which Smyth of New Orleans was the operator, is one of the most remarkable on record, but in reality affords no evidence as to the possibility of safely ligaturing the brachio-cephalic trunk. For in this case the carotid was also tied so as to stop the regurgitant flow of blood; yet, notwithstanding this precaution, on the fourteenth day severe hæmorrhage to syncope occurred. This hæmorrhage recurred at intervals for a period of thirty-seven days, and was temporarily arrested by filling the wound with shot, till, on the fifty-first day after the operation, a "terrific" hæmorrhage took place, stopped by syncope. As this bleeding came from the distal side and from the subclavian artery, the vertebral was tied, with perfect success—no bleeding recurring. This fact is of the utmost surgical value; it shows that the secondary hæmorrhage, which may be looked upon as the necessary sequence of the ligature of the innominate artery, may be arrested and the patient's life saved by the ligature of the principal arterial branch that communicates with and that carries regurgitant blood into the distal end of the artery which was originally ligatured. This fact is entirely new in operative surgery; and the establishment of it, as well as the skill and courage that were displayed in the operative procedures required in, and the general management of this case, reflect the highest credit on Smyth. I am indebted to him for the further history of this unique case. After ten years of good health, in which the patient was able to follow his employment as a ship's steward, the pulsation returned and the tumour reached a size larger than before. Thinking it might be fed by the internal mammary, Smyth ligatured that vessel, but without any result. About six months after an abscess formed over the sac, and the aneurism became diffused into it, and as a last effort to save the patient's life, Smyth performed the heroic operation of laying open the sac. The hæmorrhage was profuse, and the openings of the vessel into the sac could not be seen, so that the operator had to content himself with plugging the wound. The patient died a few days after. The post mortem examination showed that the circulation had been chiefly carried by means of the anastomoses between the aortic intercostals and the branches of the axillary artery. In three more cases the operation of ligature of the innominate is said to have been tried with speedily fatal results; and in four cases, after being commenced, it was abandoned. Death occurred from secondary hæmorrhage in seven cases; from inflammation of the lungs or pleura in one; from pericarditis in one; from diseased kidney in one; from phlebitis and suppuration in one; and in three from causes that are not mentioned.

In one case, that of Hall, the artery was transfixed by the aneurism-needle; hæmorrhage occurred at the time, which was arrested by plugging, and did not recur, the patient dying from other causes. In three cases, those of Mott, Bland, and Lizars, the hæmorrhage came on shortly after the separation of the ligature; but in Gräfe's it did not occur for fifty-one days after this, the cicatrix in the artery having then probably given way under the influence of some imprudent movement on the part of the patient. In Cooper's second case, the patient appeared to be going on well for some weeks, when secondary hæmorrhage appeared. Learning that nothing further could be done, the patient tore off the bandages when alone, and bled to death. In Bickersteth's case, the artery had been injured by the previous compression applied by means of a leaden wire. The ligature was applied on each side of the bruised spot; but secondary hæmorrhage proved fatal on the sixth day. With such results as these, there can be but one opinion as to the extreme danger of such an operation. As its performance has hitherto in every instance, except in Smyth's, entailed death, and generally a speedy death, it should without doubt be undertaken with much hesitation; and there can be but few cases in which a Surgeon would be induced, in the face of the consequences that have hitherto invariably followed the application of a ligature to the brachio-cephalic artery for subclavian aneurism, again to have recourse to such a procedure.

**Ligature of the Subclavian.**—This artery has been tied in the third part of its course for subclavian or subclavio-axillary aneurism in 21 cases (Poland). Of these, nine recovered. The sac was punctured in two cases—by Liston and Travers. The majority of the deaths were from hæmorrhage. Warren relates a remarkable case occurring in a lady aged thirty, who was afflicted by an aneurism just above the clavicle. The patient was excessively deformed from club-foot and curvature of the spine, so that the two first ribs rose above the clavicle, passing obliquely across the neck and carrying the artery upwards and backwards, so that it lay parallel to, and about an inch from, the external border of the trapezius. This peculiarity of position enabled Warren to tie the artery on the cardiac side of the tumour, and the case had a successful issue. If the aneurism be situated on the right subclavian artery, between or beyond the scaleni, that vessel has been *Ligatured on the Tracheal side* of these muscles; on the left side this operation is scarcely practicable, on account of the depth at which the artery is situated. It has, however, been performed in one case by Dr. J. R. Rodgers of New York; and it was attempted once by Sir Astley Cooper, who failed to secure the vessel, and is said to have wounded the thoracic duct. 'When we consider the anatomical relations of that portion of the right subclavian which intervenes between the brachio-cephalic artery and the tracheal edge of the scalenus anticus muscle, we are at once struck with the great difficulties of this undertaking; and when we reflect on the position in which the ligature will be placed between the onward current of blood in the brachio-cephalic on the one side, and the regurgitant stream conveyed by the vertebral, the thyroid axis, the internal mammary and superior intercostal, into the subclavian, immediately beyond the seat of deligation on the other side, we can scarcely, in accordance with those principles on which the formation of a coagulum within a ligatured vessel takes place, anticipate any but the most disastrous results.

In reference to the mere difficulties of the operation, Fergusson justly characterises it as the most serious in Surgery; the proximity of the common carotid artery on one side, the internal jugular vein on the other, the vena innominata below, the par vagum and numerous small venous trunks in front, the recurrent laryngeal nerve and pleura behind, constitute relations of sufficient importance to justify Fergusson's opinion. But supposing these difficulties overcome, and the ligature applied, this must be situated, as has just been stated, in such a position, with a strong current of blood flowing upon each side of it, as to render the formation of an internal coagulum, and consequently occlusion of the artery, impossible, and thus to lead inevitably to the occurrence of fatal hæmorrhage on the separation of the ligature. Besides the danger of secondary hæmorrhage from these causes, there would be the additional risk of the coats of the artery being diseased, as we commonly find them to be in a more or less morbid state in the immediate vicinity of aneurisms; and, thus being rendered insusceptible of healthy inflammation, ulceration and sloughing would take place along the track of the ligature, causing the probability of a recurrence of hæmorrhage. Thus, in Colles's case it was found, on exposing the subclavian artery, that the aneurism had extended in such a way towards the carotid, that it was doubtful whether any part of the affected vessel continued sound. On exposing fully, it was found that only a space of the vessel three lines in length remained free between the sac and the bifurcation of the brachio-cephalic, and it was in this narrow space that the ligature was applied.

The subclavian has been ligatured on the tracheal side of the scaleni muscles in fourteen cases, all of which proved fatal: twelve from hæmorrhage, one from inflammation of the pericardium and pleura, and one from pyæmia.

The cases are as follow:—

| SURGEON. | SEX. | AGE. | DATE OF DEATH. | CAUSE OF DEATH. |
|---|---|---|---|---|
| COLLES. | m. | 33 | 4th day. | Hæmorrhage. |
| MOTT. | f. | 21 | 18th day. | Hæmorrhage. |
| HAYDEN. | f. | 57 | 12th day. | Hæmorrhage. |
| O'REILLY. | m. | 39 | 13th day. | Hæmorrhage. |
| PARTRIDGE. | m. | 38 | 4th day. | Pericarditis and pleurisy. |
| LISTON.* | m. | ... | 13th day. | Hæmorrhage. |
| LISTON.† | m. | ... | 36th day. | Hæmorrhage. |
| CUVILLIER.‡ | m. | ... | 10th day. | Hæmorrhage. |
| RODGERS. | m. | 42 | 14th day. | Hæmorrhage. |
| AUVERT.§ | ... | ... | 11th day. | Hæmorrhage. |
| AUVERT.§ | ... | ... | 22nd day. | Hæmorrhage. |
| ARNDT. | m. | 34 | 5th day. | Pyæmia. |
| BAYER. | m. | 21 | 24 hours. | Hæmorrhage. |
| HOBART.‡ | f. | ... | 16th day. | Hæmorrhage from the carotid. |

Thus it will be seen that, while this operation is bad in principle, it is most unfortunate in practice. This appalling Table needs no comment. It is, to my mind, conclusive as to the merits of the operation, the patient having, in every case but two, been carried off by secondary hæmorrhage from the distal side of the ligature, in consequence of the close proximity of numerous collateral branches (Fig. 385); and in the two exceptional cases the operation, although performed skilfully, proved fatal in one instance from pericarditis and pleurisy, and in the other from pyæmia, before the period at which secondary hæmorrhage might have been expected. Liston, in one case, ligatured the root of the common carotid, as well as that of the subclavian, hoping in this way to diminish the risk of secondary hæmorrhage, by arresting the current of blood which, by sweeping into the carotid past the mouth of the subclavian, would necessarily wash away any coagulum that might be formed in this artery. But his expectations were not realised: hæmorrhage took place as usual, and from that portion of the artery which lay on the distal side of the ligature, the blood having been carried into this end of the vessel in a retrograde course, through the connection existing between the vessels arising from it at this point, and

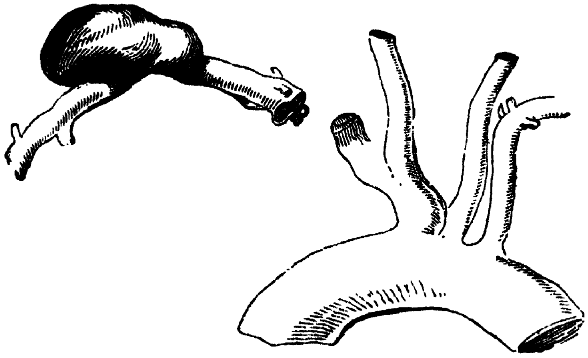

Fig. 385.—Ligature of the Subclavian in the First Part of its Course. (Liston.)

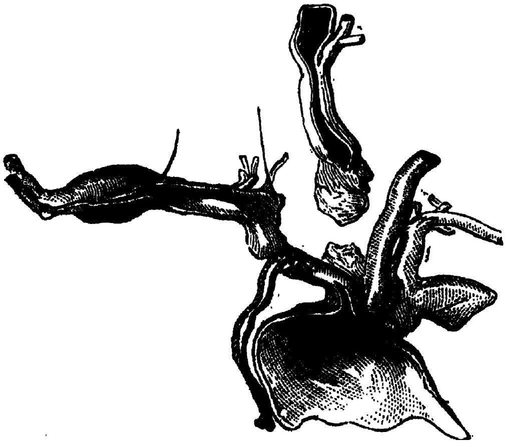

Fig. 386.—Ligature of the Subclavian and Carotid for Subclavian Aneurism. (Liston.)

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* In this case the carotid was also tied, but the hæmorrhage came from the subclavian (Fig. 386).

† Fig. 385. ‡ Carotid also tied. § Referred to by J. H. Power.

those on the opposite side of the head and neck, as illustrated by the annexed cut (Fig. 386), taken from the preparation of the case in the University College Museum. Indeed, this is the great danger to be apprehended after ligature of the subclavian artery on the tracheal side of the scaleni, depending as it does on the anatomical relations and connections of the vessel, which no skill on the part of the operator can in any way lessen, and which, in my opinion, ought certainly to cause the operation of ligature of the subclavian in the first part of its course to be banished from surgical practice.

Hobart of Cork ligatured the first part of the right subclavian and the root of the carotid in a case of aortic aneurism supposed to be innominate. The ligature separated safely from the subclavian, but the patient died on the sixteenth day of hæmorrhage from the carotid, brought on by a fit of passion, in which she threw her bolster at the nurse. Smyth of New Orleans tied the innominate, the carotid, and subsequently the right vertebral, with eventual success (Table, p. 110). The carotid only was tied by Butcher, with a fatal result.

When an aneurism is situated on the subclavian artery, in the posterior inferior triangle of the neck, it is necessarily impossible to ligature that vessel beyond the scaleni, as there would not be sufficient room for the exposure of the artery, which, even if laid bare, would in all probability be found in too diseased a condition to bear the application of a ligature.

Thus it will be seen that, in every case, except Smyth's, in which an aneurism of the subclavian artery has been subjected to operation, whether by ligature of the brachio-cephalic or of the subclavian itself *internal* to the scaleni, the result has been a fatal one. As this unfortunate termination is in no way to be attributed to want of skill on the part of the operators,—who have been, without exception, men greatly distinguished for the possession of this very quality,—but is solely dependent on certain anatomical peculiarities in the arrangement of these vessels, by which their successful ligature has been rendered all but impossible, a repetition of these attempts, which may hasten the patient's death, can scarcely be considered justifiable. What then are we to do? Are we to leave patients labouring under aneurism of the subclavian artery to inevitable death, without making an effort to save them? Or does surgery offer other modes of treatment besides those just mentioned, by which we may hope to arrive at more successful results?

Without mentioning direct pressure, manipulation, or galvano-puncture, which are certainly deserving of further trials in combination with appropriate constitutional treatment, three modes of treatment present themselves:—

1. Compression of the Artery where it passes over the First Rib, and consequently on the Distal Side of the Tumour.
2. Ligature of it on the Distal Side, above or below the Clavicle.
3. Amputation at the Shoulder-joint, and Distal Ligature of the Artery.

1. **Compression of the Artery on the Distal Side of the Sac** could only be effected where it crosses the first rib, and consequently would only be applicable to aneurisms of the first part of this vessel. This plan has never been tried: partly, perhaps, on account of the difficulty in applying pressure in this situation, and partly, probably, on account of the want of success that has attended procedures of this kind when applied to vessels in other situations.

The difficulty in applying the compression might, I think, be overcome by the use of the instrument of which a representation is given by Bourgery. The efficiency of the compression would be materially increased by the employment of direct pressure on the tumour, or of galvano-puncture at the same time, and in this way a coagulum might be formed in the sac. Although too much ought not to be expected from this mode of treatment, yet I think it might with propriety be tried in cases of the kind that has been mentioned.

2. **Distal Ligature of the Subclavian Artery in the Third Part of its Course** has been suggested, and may, perhaps, hold out some prospect of success in cases of aneurism situated between or internal to the scaleni. In an aneurismal sac springing from the artery in this situation, the principal current of blood would, in all probability, be that which is destined for the supply of the upper extremity. Some of the branches arising from the artery before it has passed beyond the scalenus anticus would, doubtless, be more or less compressed, and thus obliterated, by the tumour; or they might be obstructed by an extension of the laminated fibrine over their orifices. If, therefore, the supply to the upper extremity could be cut off, there might be a possibility of those changes taking place within the sac which are necessary for the obliteration of its cavity. The principal obstacles to this desirable result would necessarily be the transversales colli and humeri arteries; which, being the two vessels that are more particularly destined to carry on the circulation in the upper extremity after the ligature of the subclavian, would necessarily, if not occluded, undergo dilatation, and thus continue to draw too large a current of blood through the sac for stratification of its contents to take place; and, if they were occluded, there would be danger of gangrene of the arm from insufficient vascular supply.

Dupuytren ligatured the axillary artery under the pectoral muscles for a case of subclavian aneurism, two arterial branches being divided in the incisions through the fat and areolar tissue; and the patient died on the ninth day. This operation could not be expected to succeed; for between the ligature and the sac are the large and numerous alar, acromial, and thoracic branches of the axillary artery, which would continue to be fed by a current sent through the tumour, and thus preclude the possibility of its contents being sufficiently stationary for ultimate contraction and cure to result. Laugier performed the distal operation in a supposed case of subclavian aneurism, which afterwards turned out to be one of the brachio-cephalic artery. In addition to Dupuytren's case, the operation has been done by Pétrequin, Schuh, and Canton, in all instances with a fatal result.

3. The above-mentioned difficulties are met by a plan of procedure, originally suggested, I believe, by Fergusson, but which has as yet been practised in only one case. It is **Amputation of the Arm at the Shoulder-joint, followed by Distal Ligature of the Artery**—a desperate undertaking, truly, but for a desperate disease, it must be remembered, and one that under ordinary surgical treatment is almost incurable.

The artery might be ligatured before the amputation. "It is known," says Fergusson, "that amputation at the shoulder-joint is generally a very successful operation; so far as this wound is concerned, then, there might be little to apprehend, but the effect on the tumour is not so easily foretold. Ligature of the axillary artery on the face of the stump might here be reckoned like Brasdor's operation; yet there is a vast difference, for in the latter case the same amount of blood which previously passed towards the upper extremity would still find its way down, and probably part of it would run through the sac; whereas, were the member removed, as the same quantity would no longer be required in this direction, the tumour might possibly be much more under the control of pressure. The value of such a suggestion remains yet to be tested, however, and it would be futile to reason upon it at present. It might be a judicious venture first to tie the axillary or subclavian under the clavicle; and then, if it were found that the aneurism still increased, amputation might be performed, either immediately before or after the separation of the ligature."

Were a case of aneurism of the subclavian artery internal to the scaleni to present itself to me, the plan that I should adopt would be, first, the employment of pressure on the vessel at the distal side of the tumour, if practicable; should this not succeed, I would, if the disease were situated between or internal to the scaleni, ligature the artery in the third part of its course; and, did that not succeed in checking the increase of the aneurism, I would perform amputation at the shoulder-joint, as recommended by Fergusson. Should the aneurism occupy the artery after it has passed the scaleni, direct pressure on the sac holds out the best prospect of success. Should that fail, I would not attempt the ligature of the artery below the clavicle; as it is an operation the result of which is most unsatisfactory, and would not prevent a large current through the sac for the supply of the collateral circulation of the arm; but I would at once have recourse to amputation at the shoulder, and then ligature the vessel as near as possible to the sac. It is true that, even in this case, the ligature would be below the branches that are given off under the pectoral muscles; but, as the arm would be removed, they could not undergo any increase of activity for the supply of the collateral circulation of the upper extremity.

The only case in which this operation has been performed, was by Spence in 1864. The patient lived for four years; and, although the aneurism was not cured, the result afforded good promise of success for the future. For the first ten days after the operation, the tumour was scarcely to be felt; and when the patient left the hospital the tumour had diminished to one third of its former size. The artery was tied in two places—where it was cut, and also just beyond the tumour. Before the patient's death—which probably arose from internal aneurism—the aneurism had increased somewhat towards the chest.

**Ligature of the Vertebral Artery.**—This bold and difficult operation is only to be found recorded in one case in the annals of Surgery—that in which Smyth of New Orleans had recourse to it to check regurgitant hæmorrhage after ligature of the innominate for subclavian aneurism (p. 111).

I will give the details of the operation in the words of Smyth.—"The head of the patient being thrown back and slightly turned to the left, an incision two inches in length was made along the posterior border of the sterno-mastoid muscle, commencing at the point where the external jugular vein crosses this muscle and terminating a little above the clavicle; the edge of the muscle being exposed and drawn to the inner side, the prominent anterior tubercle of the transverse process of the sixth cervical vertebra was readily felt and taken for a guide. Immediately before this and in a vertical line with it lies the artery. A layer of fascia was now divided; some loose cellular tissue with lymphatics and the ascending cervical artery were pulled to the inner side; and a separation was made between the scalenus anticus and longus colli muscles just below their insertion into the tubercle, when the artery and vein became visible; the latter was drawn to the outer side (this is important), and the needle passed around the former from without inwards."

### ANEURISM OF THE AXILLARY ARTERY.

This artery, though less commonly the seat of aneurism than other large vessels, such as those of the ham, the groin, and the neck, yet is sufficiently frequently diseased. This is due partly to its situation, its proximity to the shoulder-joint causing it to be subjected to the very varied, extensive, and often forcible movements, of which that articulation is the seat; and partly to the artery being deficient in that support which would be afforded it by a strong investing sheath, such as is commonly met with in arteries of corresponding magnitude. Amongst the most frequent causes of axillary aneurism, may be mentioned falls upon the shoulder or upon the outstretched hands, and in many cases the efforts made at reducing old standing dislocations, instances of which are recorded by Pelletan, Flaubert, Warren, and Gibson; the head of the bone in these cases having probably contracted adhesions to the artery, in consequence of which the vessel was torn during the efforts at reduction. Axillary, like subclavian aneurism, occurs more commonly on the right than on the left side, and is met with in especial frequency amongst men; of 37 cases, only 3 occurred in women. I am acquainted with one case only in which both axillary arteries became aneurismal; it occurred to Furner of Brighton. In this remarkable case both axillary arteries became affected, an interval of about fifteen months intervening between the formation of the two aneurismal tumours; and the subclavian was ligatured on both sides successfully.

SYMPTOMS.—In axillary aneurism there are three sets of symptoms, attention to which will usually enable the Surgeon to recognise the disease; these are, the existence of a tumour in the axilla, the pain that it occasions, and the affections to which it gives rise in the limb.

The precise situation at which an aneurism of the axillary artery presents externally, will depend upon whether it springs from that portion of the vessel that lies above, beneath, or below the lesser pectoral muscle. If from above, it will appear as a tumour seated immediately below the clavicle and occupying the triangular space between the upper margin of the lesser pectoral and that bone; if it be lower down, it will raise the anterior fold of the axilla, being prevented from extending much out of this space by the dense fascia that stretches across from one side to the other. The tumour, which is at first soft and compressible, has a whizzing bruit; and its pulsations, which are expansile, may be arrested by pressure upon the subclavian artery, where it passes over the first rib. It usually increases with great rapidity, owing to the little resistance opposed by the loose areolar tissue in this situation, and most commonly extends downwards and forwards, causing the hollow of the axilla to disappear. In some rare instances, however, the tumour has been known to take a direction upwards under the lesser pectoral, and into the areolar interval above that muscle, or even underneath the clavicle into the acromial angle between it and the trapezius. It is fortunately rare for an aneurism to take such a course, as it would present serious difficulty in the compression or the ligature of the subclavian; and there is more than one instance on record, in which the sac has been punctured in the attempt to pass the needle round this vessel. When the aneurism is seated high up, it not unfrequently happens that the clavicle is pushed upwards by the pressure of the tumour beneath it—a complication of considerable moment in reference to the operation, the difficulties of which are greatly increased by it. The *pressure* of the tumour upon neighbouring parts may give rise to serious consequences; thus it may produce a carious state of the first and second ribs, and the compression of the brachial plexus of nerves will occasion pain and numbness in the upper extremity. The *affections* of the limb occasioned by the aneurism are diminution or extinction of the radial pulse, œdema, coldness, and loss of muscular power. In some cases the brachial artery beyond the tumour would appear to be obstructed, no pulsation being perceptible in it; and the compression of the axillary vein may occasion œdema of the hand and arm, with some diminution in the temperature of the limb; and these symptoms, if the tumour attain a very large size, may even amount to indications of impending gangrene.

DIAGNOSIS.—The diagnosis of axillary aneurism is usually readily made; there being but two diseases with which it can well be confounded, viz., chronic enlargement and suppuration in the glands of the axilla, and pulsating tumour of the bones in this region. From *glandular or other abscess,* the diagnosis is generally easy; but I have seen some cases in which, pulsation being communicated to their contents by the subjacent artery, it was somewhat difficult to distinguish the nature of the tumours. Here, however, the history of the case and its speedy progress to pointing will indicate its true nature. From *medullary tumour,* or *osteo-aneurism of the head of the humerus,* the diagnosis is not always so easy; and there are at least two instances on record in which the subclavian artery has been ligatured for disease of this kind on the supposition of its being an aneurism. In these instances it has, however, generally been observed that the tumour first made its appearance on the fore part of the shoulder, and not in the usual situation of axillary aneurism; that it was from the first firm, smooth, elastic, but nearly incompressible; and that, although it presented distinct pulsation, there was no true bellows-sound, but rather a thrilling bruit perceptible in it. The most important diagnostic mark, perhaps, is the fact of these tumours forming a prominence in situations in which aneurisms of the axillary artery would not at first show themselves, as at the upper, outer, or anterior part of the shoulder. In more advanced stages, when the substance of the bone has undergone absorption and its shell has become thin and expanded by the outward pressure of the tumour, there is often a dry crackling or rustling sound perceived on pressure, which is never met with in cases of aneurism.

TREATMENT.—I am not acquainted with any instance in which an aneurism of the axillary artery, not arising from wound or injury, has undergone spontaneous cure, or been consolidated by constitutional treatment. Compression or ligature of the subclavian in the third part of its course is the only means of cure.

Axillary aneurisms are favourably situated for the employment of *digital compression*. By this means the subclavian can easily be commanded as it passes over the first rib. And the success of this treatment is likely to be great; first, because, the sac being usually large, a considerable quantity of the contained blood is well out of the current of the circulation, readily stagnates, and may thus easily coagulate; and secondly, because the current of blood through the sac is proportionately small, and thus if coagulation once begin, may easily be completely arrested. Digital compression, therefore, in my opinion, should always be had recourse to in the first instance. By this means, aided by rest and constitutional treatment, the progress of the tumour may be stayed, and possibly a consolidation of its contents and cure be effected. This occurred at University College Hospital in a patient seventy-one years of age, in whom an axillary aneurism as large as a shaddock and of an actively progressing character was cured by intermittent digital compression continued at intervals for between two and three weeks, during which time compression was kept up in all about twenty-three hours, the consolidation commencing on the third day of compression after seven hours of pressure had been tried. Holmes mentions eight cases in which digital compression has been tried. Three of these, under the care of Ciniselli and Dutoit, and another Surgeon whose name is not mentioned, were of traumatic origin, and of these two were cured. The remaining five were idiopathic. Three of these, under Cooper Forster, Peatson, and Rizzoli, were cured. Two, under Turet and Vanzetti, failed. In Cooper Forster's case the compression was applied twice under chloroform; on one occasion for three and a quarter hours and on the other for eight hours. In Peatson's case the pressure was applied at intervals for a period of nearly three months. In Rizzoli's case the treatment lasted even longer, the cure not being complete for nearly six months. In this case the artery was so dilated and diseased that ligature was impossible. In Dutoit's case the compression was applied for six hours a day for six days.

Compression by instruments on the cardiac side can seldom be made applicable to aneurisms in this situation; inasmuch as the pressure that is brought to bear upon the subclavian must necessarily at the same time influence the greater part of the brachial plexus of nerves to such an extent as to be unendurable by the patient. Yet it is not impracticable, and means might be devised to overcome this difficulty.

Ligature of the artery is, however, still the Surgeon's chief resource in the treatment of these cases. The part of the vessel universally selected for the application of the ligature is, in accordance with the Hunterian doctrines, that which lies on the first rib beyond the scalenus anticus muscle; this part presenting the advantages of being sufficiently removed from the seat of disease to ensure the probability of the coats of the artery being in a sound state, of being by far the most accessible, and, when deligated, of allowing the collateral circulation by which the vitality of the arm is to be maintained to remain uninjured. Notwithstanding these obvious advantages presented by the ligature of the subclavian over that of the axillary artery, in other words, by performing Hunter's instead of Anel's operation for the cure of spontaneous axillary aneurism, there would appear to be a tendency in the minds of some Surgeons to advocate the latter instead of the former of these operations; and to substitute for one that offers the advantages that have just been mentioned a procedure that is not only much more difficult in its performance, and that interferes with the collateral circulation, but that is practised upon a diseased part of the vessel, in dangerous proximity to the sac.

**Ligature of the Subclavian in the Third Part of its Course.**—In order to apply a ligature to that portion of the subclavian artery which intervenes between the acromial edge of the scalenus anticus and the lower border of the first rib, the patient should be placed in the recumbent position, the arm depressed as much as possible, and the head turned somewhat to the opposite side. The integuments of the lower part of the neck should then be put on the stretch by being drawn downwards over the clavicle, and an incision about four inches in length made upon the bone through the integument, the superficial fascia, and the platysma. When tension is taken off the part, this incision will be found to traverse the base of the inferior triangle of the neck; a vertical incision should then be made at right angles to, and falling into the centre of, the first, and the two flaps of integument and fascia should then be turned up. A quantity of loose areolar tissue will now be exposed, in which a venous plexus and the lower end of the external jugular vein will commonly be found. These vessels should be carefully avoided, and the areolar tissue dissected or scratched through with the point of a knife and a blunt probe; should any vein be wounded, a double ligature must be passed underneath it, and both ends tied. If the transversalis colli or humeri arteries, as occasionally happens, should inconveniently traverse this place, they must be drawn out of the way with a blunt hook. By the combined action of cutting and scratching through the areolar tissue, the external edge of the scalenus anticus is reached; this is the "directing line" down which the finger is run until the tubercle of the first rib is felt. This is the guide to the artery, which will be found immediately above and a little behind it, covered, however, and bound down to the rib by a dense fascia. This must now be very carefully opened with the edge of the knife, and the needle passed from before backwards. In doing this, attention must be paid to the brachial plexus, situated above and behind the artery (Figs. 387, 388, 389).

There are several points in connection with this operation that deserve special attention. In the first place, it is necessary that the shoulder should be depressed as far as possible, so as to bring the superior margin of the clavicle down. This is a matter of much importance; for, if the clavicle be thrust upwards by the pressure of a large aneurism, the Surgeon will have to find the artery at the bottom of a deep narrow wound, instead of on a comparatively plain surface. A case occurred to Sir A. Cooper, in which the attempt to ligature the subclavian artery for a large aneurism of the axilla was forced to be abandoned, in consequence of the clavicle being thrust up to too great a height to enable him to reach the vessel. The extent of the difficulty occasioned by this elevation of the clavicle must necessarily depend in a great measure upon the height at which the subclavian artery happens in any particular case to be situated in the neck. It is not uncommon to find it pulsating so high in the neck, that no amount of elevation of the clavicle by a subjacent axillary aneurism could raise that bone above the level of the vessel. In the majority of cases, however, (in seventeen out of twenty-five, as shown by Quain in his work on the *Arteries*,) it is either below the level of the bone, or but slightly raised above it; so that, if the clavicle were thrust upwards and forwards, the vessel would be buried in a deep pit behind it. Dupuytren was of opinion that the artery coursed high in persons who were thin, with slender long necks; whereas, in thick, short-necked persons, with muscular shoulders, it was deeply seated. I have often verified the truth of this observation, both in dissection and in examining the pulsations of the vessel during life.

In order to obviate the difficulty that has occasionally been experienced in reaching the artery when thus buried behind an elevated clavicle, it has been proposed by Hargrave to saw through the bone. The most serious objection that can be raised against this practice, is the fact of the clavicle being sometimes a part of the wall of the aneurism; but, supposing the Surgeon could satisfy himself that this was not the case, I cannot see any objection to this procedure, provided any very great and insurmountable difficulty presented itself in passing the ligature round the vessel without it. The

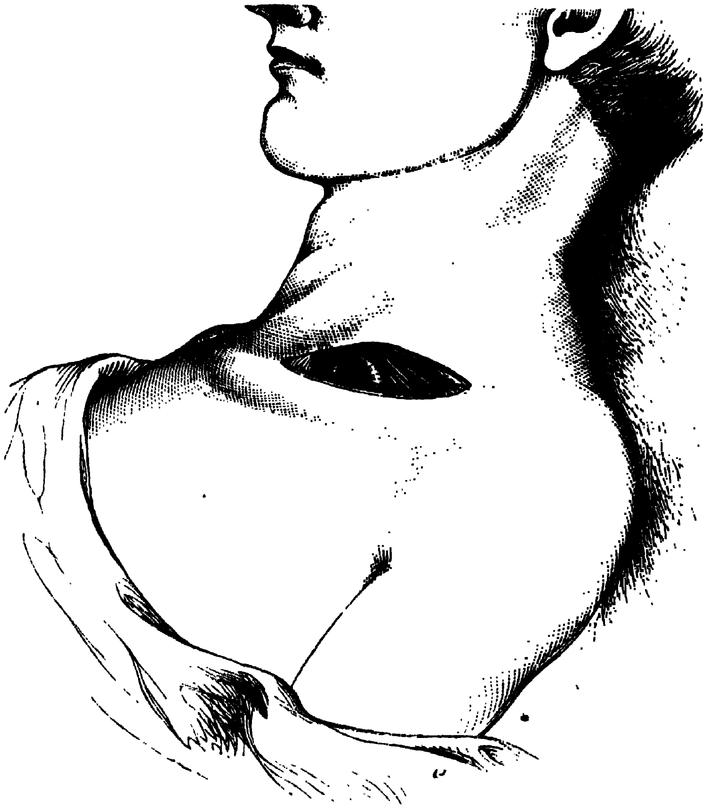


Fig. 387.—Ligature of the Subclavian in the Third Part of its Course.

posterior scapular very frequently arises as a separate branch from the third part of the artery, and must be looked out for during the operation. It is also said to influence the probability of secondary hæmorrhage. In 296 arteries examined by Quain, it arose from the third part as a separate branch in 101, or as nearly as possible one in three cases.

The external jugular vein should lie close to the outer edge of the sterno-mastoid; but it is frequently more external, and must consequently be divided in the operation between a double ligature.

In passing the needle round the subclavian, care must be taken that some of the lower cords of the brachial plexus be not included in the noose; and indeed the mistake has more than once been committed of tying these nervous trunks instead of the vessel. Thus, Liston, in the first successful case of ligature of the subclavian in this country, passed the thread round the lower nervous cord; but immediately perceiving his error, turned it to account by drawing aside the included nerve, and thus more readily exposing the artery. Dupuytren, in a case of aneurism of some years' duration, succeeded, after an operation that lasted one hour and forty-eight minutes, and which he describes as the most tedious and difficult he ever attempted, in passing a ligature round the vessel, as he believed. After the death of the patient, which occurred from hæmorrhage on the ninth day, the artery was found to have been perforated by the needle, and one half the vessel and the lower cord of the brachial plexus included in the noose. In a case related by Porter, it is stated that the artery communicated such distinct pulsation to the inferior nervous trunk, that there were no means of ascertaining whether it was the vessel or not, except by passing the needle under it.

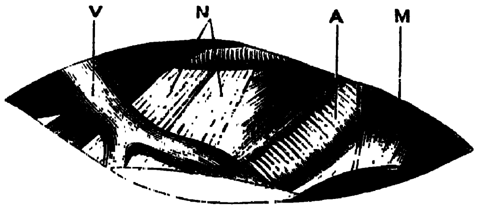


Fig. 388.—Diagram of Right Subclavian Artery in the Third Part of its Course. A. Artery. N. Brachial plexus of nerves. V. Plexus of veins. M. Edge of scalenus anticus muscle, inserted into tubercle of first rib.

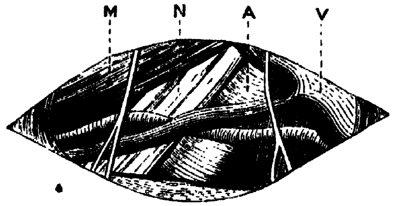


Fig. 389. — Diagram of Right Subclavian Artery in Third Part of its Course, crossed by transversalis colli artery and vein. A. Subclavian artery. V. External jugular receiving transversalis colli veins. N. Brachial plexus of nerves. M. Omohyoid muscle.

In some cases, as has already been stated, the sac passes upwards below the clavicle into the inferior posterior triangle of the neck; when this is the case, the Surgeon incurs the risk of puncturing it from its close proximity to the artery, as it lies on the first rib. This accident happened to Cusack while ligaturing the subclavian in the third part of its course, for a diffused aneurism of the axillary artery. An alarming gush of blood took place, which was arrested by plugging the wound; but the hæmorrhage recurred on the tenth day, and the patient died. In a case related by Travers, in which the sac was punctured by the needle, which was being passed round the artery, the blood, which was arterial, did not flow *per saltum*, but in a continuous stream. "The hæmorrhage," Travers says, "was more terrific and uncontrollable than I have ever witnessed," and was not commanded by drawing the ligature tight. It was so great that it was doubtful whether the patient would leave the theatre alive, and was only arrested by plugging the wound with sponge-tents. The patient died of inflammation of the pleura. On examination, the aneurismal sac was found to have a pouch-like enlargement upwards, overlying the artery, where it had been punctured. In connection with the ligature of the subclavian in this situation it is impossible to pass over in silence the fact, that in some instances the artery takes a remarkably high course in the neck, and that in some of these instances, instead of passing over the first dorsal rib, it has been supported on a supernumerary cervical rib, the anatomical relations being thus seriously disturbed. And again, if this supernumerary cervical rib be unusually short, the vessel may be found to lie between it and the first dorsal.

**Ligature between the Scaleni.**—If the sac encroach upon the neck, rising above the clavicle, or the artery be not sound in the third part of its course, it may be necessary to ligature it between the scaleni, dividing the outer half or two-thirds of the scalenus anticus. This operation should not be considered as distinct from ligature of the vessel in the third part of its course, but rather as an extension of that proceeding, if it be found, for the reasons just mentioned, unadvisable to tie the artery on the first rib; in this way it has been practised by Dupuytren and Liston. In its first steps, as far as the exposure of the scalenus anticus, it is the same as that for the deligation of the vessel in the third part of its course. When this muscle has been exposed, a director must be pushed under it, upon which it is to be divided to the extent of half or two-thirds its breadth, when it retracts, exposing the vessel. During this part of the operation, some danger may be incurred to the phrenic nerve, and to the transversales colli and humeri arteries; but if ordinary care be taken, this will not be very great. The phrenic nerve, as I have found by very frequent examinations on the dead body, lies altogether to the tracheal side of the incision, if that be not carried beyond one-half the breadth of the muscle; and should it appear to be in the way, it may readily be pushed inwards towards the mesial line, being only loosely invested by areolar tissue. I have, however, seen one instance in which the right subclavian artery was ligatured for a spontaneous cylindriform aneurism of the axilla, and the patient died on the eighth day, of pneumonia; on examination after death, the edge of the scalenus was found cut, and the phrenic nerve divided. Had the injury to the nerve in this case anything to do with the pneumonia? I do not think it improbable; as division of one phrenic nerve, by paralysing to a certain extent the diaphragm, and so far interfering with the respiratory movements, must necessarily have a tendency to induce congestion of the lung, which would readily run on to inflammation of that organ. I have likewise heard of one case in which incessant hiccough followed this operation, and after death the phrenic nerve was found reddened and inflamed, having probably in some way been interfered with during the exposure of the vessel.

Another important point in reference to the ligature of the vessel in this part of its course is, that in five cases out of six on the right side and in one-half on the left, the superior intercostal arises from the subclavian artery between the scaleni. When this is the case, there would probably be but a slender chance of the occlusion of the artery by ligature in this situation. The transversales colli and humeri arteries, though in some danger, whilst crossing over the scalenus anticus, may be avoided by keeping the incision in the muscle between and parallel to these vessels. One principal danger in ligaturing the subclavian artery at any point above the first rib, certainly arises from interference with the fine areolar tissue which lies between it and the scalenus muscles, separating it from the pleura, and which is continuous with the areolar membrane of the anterior mediastinum, being indeed the deep portion of the ascending layer of what Sir A. Cooper has described as the "thoracic fascia," and which tends to form the superior boundary of the chest, being continuous in the neck with the deep cervical fascia. After the deeper layers of the cervical fascia have been opened, this fine areolar membrane presents itself; and, if inflammation be excited in it, the morbid action will readily extend by mere continuity of tissue into the thorax by the anterior mediastinum, invading ultimately the pleura and pericardium. Hence, whenever it is practicable, the Surgeon should keep the point of the needle close to that part of the artery which lies upon the first rib, as there is less risk here of opening into the deep areolar tissue of the neck.

**Accidents following Ligature of the Subclavian.**—The general result of the ligature of the subclavian artery in the third part of its course, for spontaneous aneurism in the axillary, is by no means satisfactory. Thus, of forty-eight cases of aneurism of the axillary artery, not dependent upon any external wound, in which the artery was ligatured above the clavicle, I find twenty-three cures against twenty-five deaths. This result is so unfavourable, and so different, indeed, from what I anticipated, that I have been led to analyse carefully the causes of the deaths. I find them as follows:—

| | |
|---|---|
| Inflammation within the chest, &c. | 10 cases. |
| Suppuration of the sac | 6 " |
| Suppurative phlebitis | 1 " |
| Hæmorrhage | 3 " |
| Gangrene of hand and arm | 1 " |
| General gangrene | 1 " |
| Not stated | 3 " |
| | 25 " |

Thus it will be seen that the two most frequent causes of a fatal result following the operation for axillary aneurism, are not those that are usually met with after the ligature of the larger vessels. It would therefore appear to be owing to some special condition, dependent either upon the application of a ligature to the subclavian artery in the third part of its course, or upon the situation and nature of the disease for which that operation is had recourse to; and the important point to be determined is, whether these conditions are the accidental or the necessary consequences of the application of a ligature in this situation for the cure of aneurism in the axilla.

*Inflammation of the Contents of the Thorax* proved fatal in 10 out of 25 cases, or 1 in 2·5, and is the most frequent cause of death, though not, I believe, the most frequent untoward complication of this operation. It might at first be supposed that, in this respect, the operations on the subclavian artery resembled other of the greater operations, after which pyemic pneumonia is so common a sequela ; but, on closer examination, it will be found that this is not the case. Inflammation, when attacking the thorax or its contents after ligature of this artery for axillary aneurism, is not confined to the lungs, but very commonly affects the pleura and pericardium as well as, or even in preference to, these organs. It would, therefore, appear probable that it arose from causes that are essentially connected either with this operation or with the aneurism itself. These are referrible to three heads.

1. Inflammation of the deep areolar tissue at the root of the neck may extend to the anterior mediastinum, the pleura, and pericardium. This would appear to have been the cause of death in a patient in whom Key tied the subclavian, and has been especially adverted to by that excellent Surgeon in his relation of the case.

2. The sac may, by its pressure inwards, encroach upon and give rise to inflammation of that portion of the pleura which corresponds to its posterior aspect. This occurred in a case in which Mayo of Winchester operated, and is more liable to happen if suppuration have taken place in the sac ; when this occurs, adhesion may take place between it and the pleura, or even the tissue of the adjacent lung ; and the contents of the suppurating tumour may be discharged into the pleural cavity or air-tubes, and so coughed up. Of this curious mode of termination there are at least two cases on record ; one by Bullen, in which the patient recovered ; the other by Gross, in which the patient died from the escape of the contents of the sac into the cavity of the pleura.

3. Division of the phrenic nerve would necessarily, by interfering with the respiratory movements, induce a tendency to congestion and inflammation of the lungs ; and, although such an accident must be a very rare one in cases of ligature of the subclavian for axillary aneurism, yet it undoubtedly has occurred, as I have myself witnessed in one case.

*Suppuration of the Sac* is the most common, though not the most fatal, accident after ligature of the subclavian for spontaneous axillary aneurism. It was the immediate cause of death in six cases, and occurred in two of the patients that died of inflammation of the chest ; it also took place in six cases that recovered : in all, fourteen cases out of forty-five, or nearly one in three, —a much higher proportion than is generally observed in cases of ligature for aneurism.

What occasions this greater frequency of suppuration of the sac in axillary aneurisms than in those in other situations ? The only cause to which it appears to be attributable is the great laxity of the areolar membrane in the axilla, which allows the tumour to increase so rapidly in size as to excite inflammatory action in the surrounding tissues, which may speedily run into suppuration. So long as the contents of the tumour continue fluid, they will necessarily excite less irritation on surrounding structures ; but when once they have become solidified, whether by the gradual deposition of laminated fibrine, during the progress of the disease, or more suddenly, in consequence of those changes that take place in the contents of an aneurismal sac after the ligature of the artery leading to it, the indurated mass, acting like any other foreign body, sets up inflammation in the areolar tissue that is in immediate contact with it, and thus disposes it to run into suppuration. The more speedily the solidification takes place, the more disposition will there be to the occurrence of this accident; the neighbouring parts being unable to accommodate themselves to the sudden extension and compression they are compelled to undergo. It is probable also that the proximity of the ligature, and perhaps actual injury done to the aneurismal sac during the operation are, in many cases, the immediate causes of the inflammation and suppuration. The statistics collected by Koch show a much greater mortality in those cases in which the subclavian artery has been tied for spontaneous aneurisms extending above the upper border of the pectoralis minor, than in those below that point. Of 17 of the former 13 were fatal, of 22 of the latter only 10 died.

The period at which suppuration of the sac may be expected to occur in cases of axillary aneurism, after the ligature of the subclavian, must necessarily in a great measure be dependent on the state of the sac at the time of the operation. If inflammatory action have been already set up around it, it may happen in a few days after the artery has been tied. But if this morbid action have not already commenced, the period at which suppuration may most probably be expected is between the first and second month. The period at which suppuration and rupture of the sac take place does not influence the probable termination of the case to any material extent; as, in the cases that proved fatal, death occurred at various periods between the seventh day and the second month; in Aston Key's case, on the ninth day; in Mayo's on the twelfth; in Belardini's and Gräfe's, at the end of the first month; in Rigaud's at the sixth week; in B. Cooper's, in the second month. The recoveries, likewise, took place at all periods after the ligature of the vessel, between a few days, as in Porter's, and six weeks, as in Halton's case.

An axillary aneurism that has suppurated may burst either externally, or into the lungs or pleura, or both. It is most usual for it to burst externally; the tumour enlarges, with much pain and tension; a part of the skin covering it becomes inflamed; fluctuation can be here felt, and, if an incision be not made, the tumour will give way, discharging most usually a quantity of dark-coloured pus, mixed up with more or less broken-down and disintegrated coagulum and fibrinous deposit, and perhaps sooner or later followed by a stream of arterial blood.

Occasionally, but more rarely, the sac extending backwards becomes adherent to the pleura, and may give way into its cavity; or, by pressing upon the lungs, may become incorporated with them. Of this remarkable termination two instances are recorded, in one of which recovery took place.

The first case of the kind, is one in which Bullen ligatured the subclavian artery for axillary aneurism. Eighteen days after the operation the tumour began to increase, and to take on the symptoms that are indicative of suppuration. On the twenty-sixth day six or eight ounces of bloody pus were expectorated during a paroxysm of coughing, and the tumour suddenly diminished to one half its size; it was now punctured, and five ounces of the same kind of matter were let out with great relief. When the patient coughed, air passed into and distended the sac through an aperture between the first and second ribs, near their sternal extremities, through which the contents of the tumour had escaped into the lung. The discharge from the external aperture greatly decreased; the cough lessened; and finally, three months after the operation, the patient was quite well.

Gross tied the subclavian artery for axillary aneurism on the 18th of February. After the performance of the operation the contents of the tumour solidified, and its volume progressively diminished. On the 15th of March, the patient suffered from fever, and slight tenderness on the apex of the tumour was perceptible. On the 16th he was suddenly seized with intense pain in the chest, which was particularly severe at the base of the right lung, and extended up towards the axilla. The respiration throughout the right lung was bronchial, and there was dulness on percussion over the lower ribs; the aneurismal tumour had suddenly disappeared at the time of the attack. On the 18th, the patient experienced a sensation as if a fluid were passing from the pleuritic cavity into that of the aneurismal tumour; and, upon auscultating, a plashing sound was heard at every inspiration, the noise resembling that produced by shaking water in a closed vessel. On the 20th, he died. Upon dissection, the aneurism was found to communicate by an aperture, one inch and three-quarters in length and an inch and a half in width, with the pleural cavity; this opening was situated between the first and second ribs, and was obviously the result of ulceration and absorption, caused by the pressure of the tumour. Both ribs were denuded of their periosteum. The right side of the chest contained nearly three quarts of bloody serum, intermixed with laminated clots and flakes of lymph; the former of which had evidently been lodged originally in the aneurismal sac.

Besides these cases, a somewhat similar one has been recorded by Neret, of Nancy. A patient was admitted into the hospital, labouring under hæmoptysis, and on examination was found to have an aneurism of the left subclavian artery as large as a chestnut. He died shortly after admission; and, on examination, the aneurism was found to communicate with a large cavity in the upper part of the lung.

The cause of death in Gross's case was probably the fact of the sac opening and discharging its contents into the pleural cavity. This does not appear to have occurred in Bullen's, in which a communication was established directly with the lung, the contents of the abscess finding exit through the air-tubes. The process here was analogous to what occasionally occurs in hepatic abscess when this opens through the lungs, adhesion having previously taken place between the opposed surfaces of the pleura.

In Furner's case of axillary aneurism, both arteries became affected by the disease, and both subclavians were tied in the third part of their course at an interval of about fifteen months. In this most remarkable and interesting case, the result of which reflects much credit on the skill and decision of the operator, the patient, a stone-mason by trade, made an excellent recovery from the first operation. After the second operation he progressed most favourably for twelve weeks, by which time the tumour had diminished so much as to be not more than a third of its original size. Without obvious reason febrile disturbance set in, the tumour enlarged again, and showed signs of suppurating. Furner now made a free incision into it through the pectoral muscle, and let out 18 or 20 ounces of very offensive pus and broken-down coagulum. The patient speedily recovered, the tumour disappearing entirely.

The principal danger, and the most frequent cause of death after the suppuration of the sac, is the supervention of profuse arterial hæmorrhage. This may either occur from the distal extremity of the artery opening into the sac, or from one of the large branches which serve to support the collateral circulation round the shoulder, such as the subscapular or posterior circumflex, coming off either immediately above or below the sac, or from the sac itself. When hæmorrhage does not take place after the suppuration of the sac, it must be from the fortunate circumstance of the occlusion of the main trunk, where it opens into the tumour. It can scarcely be from the occlusion of the principal collateral branches: as there would, in this event, be a difficulty in the preservation of the vitality of the limb. It is easy to understand that, if the sac sprang from the axillary, at a little distance above the orifices of the subscapular and circumflex arteries, all that portion of the main trunk which intervenes between the tumour and these vessels might be occluded, and thus hæmorrhage be prevented on suppuration taking place; whilst the collateral circulation would take place uninterruptedly through these vessels. If this portion of the artery have not been occluded by inflammatory action, the safety of the patient must depend upon the accident of a coagulum or piece of laminated fibre being fixed or entangled in the mouth of the sac. This may prevent for a time the escape of arterial blood, which, on such a plug being loosened, may break forth with impetuosity, and either at once, or by its recurrence at intervals, carry off the patient.

Another danger may be superadded in these cases on the suppuration of the sac and the supervention of hæmorrhage—namely, the occurrence of inflammation of the pleura, lung, and pericardium, from the extension inwards of the morbid action going on in the sac.

*Secondary Hæmorrhage* does not frequently occur in cases of ligature of the subclavian artery in the third part of its course, except as a consequence of suppuration of the sac. I am acquainted with two cases only in which death occurred from the hæmorrhage taking place from this artery at the part ligatured. One of these happened to Liston, and the preparation is preserved in the Museum of the College of Surgeons (No. 1695). In this case, it may be seen that the artery was diseased at the point ligatured, and that the bleeding occurred, as usual, from the distal side of the ligature.

*Gangrene of the Hand and Arm* is but seldom met with as a sequela of the operation we are considering. This is doubtless owing to the freedom of the anastomosing circulation between the branches of the transversales colli and humeri, and those of the subscapular, circumflex, and acromio-thoracic arteries, as well as between the superior and long thoracic and the branches of the intercostals and internal mammary, by which the vitality of the limb is readily maintained. The principal risk from gangrene would doubtless arise from the subscapular artery being in any way occluded or implicated in the disease, as it is on the anastomoses of this vessel that the limb is mainly dependent for its supply of blood. But, at all events, this danger is small, the only case in which it appears to have given rise to a fatal termination being one in which Collis tied the artery; gangrene of the limb came on after much constitutional disturbance of a low type, with rapid, weak pulse, thirsts, sweats, restlessness, and delirium. In Blizard's case, there were sloughing of the sac, and pericarditis, the gangrene being confined to two fingers: and in Brodie's case, it occurred in both the lower as well as in the upper extremities, and must, therefore, have proceeded from some constitutional cause altogether independent of the mere arrest of circulation through the subclavian.

**Treatment of Inflamed Axillary Aneurism threatening Suppuration.**—The case of an axillary aneurism becoming inflamed, and threatening to run into suppuration *before* the Surgeon has had an opportunity of ligaturing the subclavian artery, is one that is full of important practical considerations, and that admits of little delay; for if the sac rupture, or be opened, fatal hæmorrhage is the necessary and inevitable result. It would obviously be impossible, in a case of spontaneous aneurism, with any fair chance of success to lay open the tumour, turn out the coagula, and ligature the vessel above and below the mouth of the sac; the coats of the artery, being not only diseased, but still further softened by inflammation and supervening suppuration, would not be in a condition to hold a ligature. There are two other courses open—viz., ligature of the vessel, or amputation at the shoulder-joint; and in the selection of one or other of these, the Surgeon must be guided by the progress the disease has made, the condition of the limb as to circulation and temperature, and the solidity or fluidity of the contents of the tumour.

If the tumour be of moderate size and circumscribed, and the arm of a good temperature and not very œdematous, *ligature of the artery* may hold out a reasonable chance of success. It is true that this is but a chance: for the blood will, immediately after the noose is tied, be carried by the suprascapular and posterior scapular arteries into the subscapular and circumflex, and by them into the axillary at no great distance from the mouth of the sac; or it may enter directly into the mouth of the latter, if the subscapular or circumflex should chance to take their origin from the dilated portion of the vessel. Hence, the only safeguard against the supervention of hæmorrhage as soon as the sac has burst or been opened, or has discharged its contents, will be the occlusion by inflammatory action of that portion of the artery which intervenes between these two collateral branches and its mouth, or the accidental entanglement in the latter of a mass of laminated fibrine. Yet, in the circumstances as to the condition of tumour and limb that have just been mentioned, it would be but right for the Surgeon to give the patient a chance of preserving his limb.

Should, however, hæmorrhage occur on or after the discharge of the contents of the sac, the subclavian having previously been ligatured, what should be done? If the bleeding be moderate, an attempt should be made to arrest it by plugging the wound, and by the application of a compress and bandage. If it recur, or be so profuse as to threaten the life of the patient, what course should the Surgeon then pursue? Two lines of procedure are open to him: either to cut through the pectoral muscles so as to lay the sac open fully, and attempt to include the bleeding orifice between two ligatures; or to amputate at the shoulder-joint.

If a Surgeon were to undertake the first of these alternatives in a case of spontaneous aneurism, of which alone we are now speaking, he would, in all probability, find the part in such a condition as would prevent the possibility of his completing the operation he had commenced. After laying open a large sloughing cavity, extending under the pectoral muscles perhaps as high as the clavicle, and clearing out the broken-down coagula and grumous blood contained in it, in what state would he find the artery? Certainly, the probability would be strongly against its being in such a condition as to bear a ligature, even if it could be included in one. Its coats, in the immediate vicinity of the sac, could not, in accordance with what we know to be almost universally the case in spontaneous aneurisms of large size or old standing, be expected to be in anything like a sound firm state, and would almost certainly give way under the pressure of the noose; or the vessel might have undergone fusiform dilatation, as is very common in this situation, before giving rise to the circumscribed false aneurism, in which case it would be impossible to surround it by a ligature; or, again, the subscapular or circumflex arteries might arise directly from, and pour their recurrent blood into, the sac or the dilated artery, and, as they would lie in the midst of inflamed and sloughing tissues, no attempt at including them in a ligature could be successfully made. In such circumstances as these, the danger of the patient would be considerably increased by the irritation and inflammation that would be occasioned by laying open and searching for the bleeding vessel in the sac of an inflamed, suppurating, and sloughing aneurism, and much valuable time would be lost in what must be a fruitless operation; at the close of which it would, in all probability, become necessary to have recourse to disarticulation at the shoulder-joint, and thus remove the whole disease at once. I should, therefore, be disposed to have recourse to *disarticulation at the shoulder-joint* at once, in all cases of profuse recurrent hæmorrhage, following sloughing of the sac of an axillary aneurism, which could not be arrested by direct pressure on the bleeding orifice, after the subclavian has been tied.

There is another form of axillary aneurism that requires immediate amputation at the shoulder-joint, whether the subclavian artery have previously been ligatured or not; it is the case of diffuse aneurism of the armpit, with threatened or actual gangrene of the limb.

**Ligature of the Axillary Artery.**—Should ligature of the axillary artery at any time be required, the vessel may be secured in two ways, in the space that intervenes between the lower margin of the clavicle and the fold of the axilla.

The first way is by an incision, either straight or somewhat semilunar, parallel to and immediately below the inferior border of the clavicle; this must be carried through the pectoral muscle, and, when this is divided, some loose areolar tissue, in which the acromio-thoracic artery ramifies, is exposed. This must be scratched through cautiously, until the fascia covering the vessels is reached. On opening this, which must be done in the most careful manner by making a small aperture in it, and then passing a grooved director under it, the vein first comes into view. This must be drawn downwards, when the artery will be found immediately above it in the deep hollow formed by the clavicle above, and the edge of the lesser pectoral below. This operation is an exceedingly difficult one, on account of the depth and narrowness of the wound and the muscular character of its walls, as well as from the embarrassment occasioned by the numerous venous and arterial branches which ramify across the space in which the artery lies. After the vessel has been exposed, the passage of the ligature around it will be greatly facilitated by bringing the arm to the side of the body, so as to take off all tension from the wound (Fig. 390).

The safer and simpler operation consists in making an incision from the centre of the clavicle directly downwards, in the course of the vessels, to the middle of the anterior fold of the axilla. In this way the skin, superficial fascia, and greater pectoral muscle, must be successively divided. The lesser pectoral will then be exposed; and the artery may either be ligatured below this, without further division of muscular substance, or if it be thought desirable to deligate it under this, the muscle must be cautiously cut through.

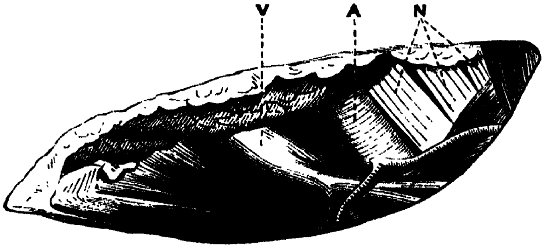


Fig. 390.—Diagram of Left Axillary Artery below clavicle. A. Axillary artery giving off thoracico-acromialis. V. Axillary vein receiving cephalic. N. Brachial plexus of nerves. The great pectoral muscle is cut across.

When this is done, a very distinct and firm fascia will come into view; this being pushed up, must be carefully opened, when the artery and vein will be seen lying parallel to one another, the artery not being overlapped by the vein, as it is higher up. The vein having been drawn inwards, the aneurism-needle must be carried from above downwards between it and the artery. The great advantage of this operation is, that the wound is open and free, and that, consequently, the artery can be more readily reached in any part of its course. The disadvantage is the great division of muscular substance that it entails. This, however, need not leave any permanent weakness of the limb, as by proper position ready and direct union may be effected between the parts.

The axillary artery may also be ligatured at any point below the lower border of the pectoralis minor, by making an incision parallel to its course in the axilla. The guiding point for the vessel in this situation is obtained by dividing the space between the anterior and posterior folds of the axilla into three equal parts, when the artery will be found to lie at the junction of the anterior with the middle third. The arm being held at a right angle to the trunk, so as to make the skin tense, an incision is made, commencing at the thoracic border of the axilla and extending for a distance of about three inches parallel to the course of the artery. The incision must be made so as to divide the skin only. The fascia being exposed, must be carefully opened, when the axillary vein will come into view, and must be drawn on one side with a blunt hook. The artery will now be seen surrounded by the nerves of the brachial plexus. In front of it or to its inner side is the internal cutaneous. To its inner side are the ulnar and the nerve of Wrisberg. To the outer side are the median, and, for a short distance above, the external cutaneous. Behind are the musculo-spiral and the circumflex, as far as the lower border of the sub scapularis muscle. The nerves are easily held aside, and the ligature is passed round the artery. If the ligature be applied near the termination of the axillary artery, as it lies over the tendons of the latissimus dorsi and teres major, it will not be in immediate contiguity to any large branch. Above this point, it must be applied close to either the subscapular or the circumflex arteries, which would perhaps somewhat add to the danger of secondary hæmorrhage. The operation is one which can very rarely be necessary in the treatment of aneurism.

### ANEURISM OF THE ARM, FOREARM, AND HAND.

Spontaneous aneurism rarely occurs below the axilla, yet it may occasionally be met with at any part of the upper extremity. Thus Palletta, Flajani, Pelletan, and others, relate cases of spontaneous aneurism at the bend of the arm ; and Liston states that he once tied the brachial artery in an old ship-carpenter, who, whilst at work, felt as if something had snapt in his arm. Pilcher has recorded a case of aneurism under the ball of the right thumb, which was produced by repeated though slight blows with the handle of a hammer used by the patient (a working goldsmith) in his trade ; the radial and ulnar arteries were tied immediately above the wrist, and the disease was thus cured. Aneurism has also been met with in this situation after attempted reduction of a dislocation of the thumb. In the Museum of the College of Surgeons there is a preparation of a radial artery with a small aneurism, about the third of an inch in diameter, formed by the dilatation of all the coats of a narrow portion of one-half the circumference of the vessel, a little above the origin of the superficialis volæ. Spontaneous aneurism in the forearm is of extremely rare occurrence. A case has been reported by Todd as occurring in a woman twenty-eight years of age, in which a spontaneous aneurism in the forearm had existed for several years before the brachial was ligatured, when pulsation in the tumour ceased, though it continued solid and hard for some months after the operation. De Morgan has recorded a case of spontaneous aneurism of the ulnar, and Spanton one of the radial artery. In neither case was any operation performed. In 1849, a man was admitted into University College Hospital, for a tumour that presented all the characters of aneurism, situated in the upper third of the ulnar artery of the right forearm. The brachial was ligatured by Arnott, when pulsation and bruit ceased in the tumour, though slight enlargement of the arm continued for some time afterwards. In most of the cases in which the brachial artery and its primary branches have been the seat of spontaneous aneurism, disease of the heart and of the arterial system in other parts has co-existed.

While spontaneous aneurisms are rare in these situations, the traumatic forms of the disease are, as has already been stated (Vol. I., pp. 326, 327), of more frequent occurrence, and may require the ligature of the brachial, or of either of the arteries of the forearm.

**Treatment.**—In cases of aneurism below the axilla, direct pressure may be tried with advantage, provided the tumour be of small size and unattended by inflammation of the superjacent integuments. Compression of the trunk of the artery above the tumour is rarely applicable, on account of the pain that is induced by the pressure upon the neighbouring nerves, which cannot be isolated from the artery. Besides this, the brachial artery is so mobile, and the humerus so small and round a bone, that the vessel cannot be steadily compressed against it for any length of time, but will roll away from under the pressure, even if the patient could bear the pain of it.

**Ligature of the Brachial Artery.**—The brachial artery may be ligatured in the *middle of the arm*, which is considered the seat of election of this operation, by making an incision, about three inches long, parallel to and upon the inner edge of the biceps, which is the "directing line;" the fascia, which is exposed, must be opened carefully to a corresponding extent, when the median nerve will commonly be seen crossing the wound; this must be drawn downwards with a blunt hook, when the artery, accompanied by its two veins, will be exposed; these vessels must then be separated from one another, and the ligature passed and tied in the usual way. In performing this operation, the principal point to attend to is to cut down upon the inner edge of the biceps, which will be the sure guide to the artery (Fig. 391). If the Surgeon keep too low, he may fall upon the ulnar nerve and the inferior profunda artery, which might possibly be mistaken for an abnormally small brachial; by taking care to expose the fibres of the biceps in his early incision, he will avoid this error.

In the *upper part of the arm*, the brachial artery, where the axillary terminates in it, will be found lying immediately behind and covered by its vein. On drawing this to the inner side, the artery will be seen, surrounded by nerves. It has in front the inner cutaneous; the ulnar and nerve of Wrisberg to the inner side; behind, the musculo-spiral; and on the outer side, the median. In ligaturing the artery in this situation, care must be taken to divide the integuments, which are extremely thin, with great caution. By rotating the arm outwards and bending the elbow, the artery will be thrown forward and rendered less tense, so that a ligature can easily be passed round it.

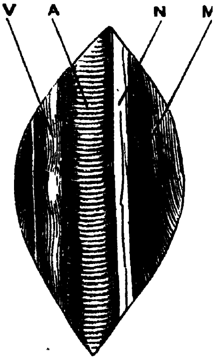


Fig. 391.—Diagram of Right Brachial Artery in middle of its course. A. Brachial artery. V. Venæ comites. N. Median nerve. M. Edge of biceps muscle. This diagram should be viewed horizontally.

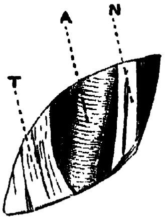


Fig. 392.—Diagram of Right Brachial Artery at bend of elbow. A. Artery. N. Median nerve to inner side. T. Biceps tendon to outer side.

At the *bend of the arm*, the brachial artery may be reached by making an incision, about two inches in length, in a direction downwards and outwards, about half an inch internal to the edge of the tendon of the biceps, parallel to the median basilic vein. As soon as the integumental structures are divided, the strong process of fascia from the tendon of the biceps will come into view, beneath which the artery lies accompanied by its veins, in the triangular space bounded externally by the biceps tendon, and internally by the pronator teres. In performing this operation, the veins at the bend of the arm, with the filaments of the internal cutaneous nerve, must be divided to some extent, though they should be spared as much as possible. The artery will be found about half an inch to the inner side of the tendon, accompanied by the median nerve, which is to its ulnar side (Fig. 392).

**Ligature of the Radial and Ulnar Arteries.**—These arteries should never be ligatured *above the middle third of the arm*, except in cases of direct wound. Any attempt at tying them in the upper part of the fore-arm will not only be attended with great difficulty, but with the danger of crippling the muscles in this situation, and thus impairing the after-movements of the arm. Ligature of the brachial artery may always be substituted advantageously.

The **Ulnar Artery** above the wrist may be readily ligatured by making an incision about two inches in length, a little above and one-third of an inch to the radial side of the pisiform bone, parallel to the tendon of the flexor carpi ulnaris, which is the "directing line" to the vessel. After the fascia covering it has been divided, the artery, with its two accompanying veins, will be found to the radial side of the ulnar nerve (Fig. 393).

The **Radial Artery** may be ligatured near the wrist, by making an incision, about two inches in length, half an inch to the outside of the tendon of the flexor carpi radialis—the "directing line" (Fig. 394); when, after the division of the superficial and deep fasciæ, the artery, accompanied by its two veins, will be exposed, and may be tied in the usual way.

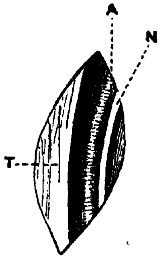


Fig. 393.—Diagram of Left Ulnar Artery at wrist. A. Ulnar artery. N. Ulnar nerve. T. Tendon of Flexor carpi ulnaris.

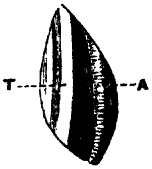


Fig. 394.—Diagram of Left Radial Artery at Wrist. A. Radial artery. T. Tendon of Flexor carpi radialis.

# CHAPTER XLV.

## ANEURISMS OF THE ABDOMEN AND LOWER EXTREMITIES.

### ANEURISM OF THE ABDOMINAL AORTA AND ITS BRANCHES.

As until recently any surgical treatment of these aneurisms was considered impossible, they were formerly left entirely in the hands of the physician; but since the introduction of compression of the aorta under prolonged anæsthesia, by Murray of Newcastle, they have become fairly entitled to a place in a work on Surgery.

**Aneurism** may affect the **abdominal aorta** at any part of its course, but the most common situation is near the origin of the cœliac axis; and here the disease is frequently not confined to the main trunk, but one or more of the branches are also affected. The next most frequent situation is at or near the bifurcation. Aneurisms may also form in connection with any of the main branches of the abdominal aorta, most frequently on the superior mesenteric, splenic, and inferior mesenteric. The aneurism may be sacculated or tubular. When growing from the main trunk, it is most frequently of the former variety.

Symptoms.—The chief sign of the disease is the existence of a pulsating tumour, situated in or near the middle line, somewhere between the costal margin and the region of the umbilicus. The pulsation of the tumour is of the expansile kind characteristic of aneurism, and there is frequently a distinct bruit. Walshe mentions a single systolic murmur, a dull muffled systolic sound convertible into a murmur by a little pressure, a sharp, abrupt, short systolic murmur at the left lumbar spine, a systolic murmur audible below the sac, but not over it, and occasionally a dull second sound, as having been heard in various cases of abdominal aneurism. The exact shape and size of the tumour and the nature of its pulsation can in many cases only be ascertained by fully relaxing the abdominal muscles by the use of chloroform. The sensation of pulsation in the epigastrium may be very perceptible to the patient, or may be entirely absent. Constant aching lumbar pain is a very frequent symptom. The pressure-signs are not usually very marked till late in the disease. Pressure on the vena cava to such an extent as to cause œdema of the lower extremities is almost unknown. The sac may press on the lumbar plexus, and give rise to signs of irritation in the course of its branches. The most marked of these are pains in the groin and testicles from irritation of the genito-crural, and occasionally shooting pains down the thigh, in the course of the anterior crural or external cutaneous nerve. When the bodies of the vertebræ are eroded, constant lumbar pain will be frequently present, of the same burning, boring character as that felt in thoracic aneurism under similar circumstances. In some cases the pressure may affect the great intestine, causing considerable difficulty in defæcation. Occasionally the tumour may attain to an enormous size before death, half filling the cavity of the abdomen. The fatal termination may be due to gradual exhaustion from pain and interference with the functions of the abdominal viscera, to sudden rupture of the sac into the peritoneum or subperitoneal tissue, or into some part of the alimentary canal, or, more rarely, into the pleural cavity through the diaphragm.

The DIAGNOSIS rests chiefly on the situation of the tumour, its distinct expansile pulsation, the existence of an aneurismal bruit, and the pressure-signs. Very *marked epigastric pulsation* is not an unfrequent symptom in anæmic patients suffering from atonic dyspepsia, and in these cases very slight pressure on the artery from a stethoscope will give rise to a distinct bruit. Under these circumstances, it is sometimes not easy to speak positively as to the condition of the artery, but in the vast majority of cases a careful examination under the influence of chloroform will readily determine the nature of the disease. A *displaced or enlarged heart* also gives rise to distinct epigastric pulsation, but this can hardly be mistaken for aneurism. A *solid mass of fæces* accumulated in the transverse colon may receive a very distinct impulse from the aorta, but the doughy feel of the mass, its superficial nature, and the history of the case, will usually readily determine its nature. A *prominent lumbar vertebra* pushing the aorta forward may also simulate a dilatation of the artery. *Cancerous lumbar glands* surrounding the artery may give rise to considerable difficulty in diagnosis; and here again a careful examination under chloroform is the most likely means of arriving at a correct conclusion. *Cancerous tumours* growing from the *bones* may give rise to almost insuperable difficulties in the diagnosis. From *tumours of the various abdominal viscera*, the diagnosis must be made on general principles. The amount of fat in the abdominal walls necessarily has a great influence on the difficulty or ease of coming to a definite conclusion.

TREATMENT.—In all cases of aneurism of the abdominal aorta, constitutional treatment should be given a fair trial before any more severe measures are adopted. Tufnell has recorded two cases in which a cure was effected by diet and rest—in one case in 21 days, and in the other in 37. If this treatment fail, the only resource left is **compression of the abdominal aorta.** The pain of this application is usually very severe, so that, in order to relieve it, patients should be kept under the influence of chloroform for many hours. The credit of introducing this mode of treatment is undoubtedly due to Murray of Newcastle-on-Tyne. The operation has now been performed for aortic aneurism in eight cases. In six, under Murray, Durham and Moxon, Durham, Greenhow and Hulke, Pollock, and Sir James Paget, the pressure was applied on the proximal side of the sac. Of these, three—Murray's, Durham and Moxon's, and Greenhow and Hulke's—were successful; one, Pollock's, failed; and two, Durham's second case, and Sir James Paget's, were fatal. In two the pressure was applied on the distal side of the sac; one, under Bryant, terminated fatally, and the other, under Marshall, failed. In every case the pressure has been applied by the instrument known in this country as Lister's aortic tourniquet. That this instrument may be safely applied to the abdominal aorta from the highest point at which the artery can be reached to its bifurcation, is clearly proved by results of the cases above mentioned. In Durham and Moxon's case, it is stated that "by positioning the body of the patient, just sufficient space was afforded for the introduction of the pad of the tourniquet between the catilages of the ribs and the aneurism." In Greenhow and Hulke's case it was applied midway between the xiphoid cartilage and the umbilicus, immediately above the tumour. That three out of the eight cases have terminated fatally shows, however, that the operation is by no means devoid of danger. In Pollock's unsuccessful case the patient suffered from hæmaturia, and in Greenhow's case albumen appeared in the urine after the last operation, thus showing serious interference with the circulation in the kidney. In Marshall's case the patient suffered from retention of urine for some days after one operation, probably from some injury to the hypogastric plexus. In Bryant's case the *post mortem* examination showed bruising of the mesentery and intestine and peritonitis, and "the tissues about the compressed aorta were loaded with effused blood." In Paget's case an abscess had formed in the mesentery, peritonitis had been set up, and the mesenteric artery was found to be compressed and flattened, and embolic clots were found in its branches. In Durham's fatal case there were signs of bruising about the pancreas, and the aneurism was found to affect the mesenteric artery. The time during which the pressure has been maintained has varied considerably. Murray's case was cured by one application lasting five hours; Durham and Moxon's in 10½ hours; Greenhow and Hulke's, by three applications, lasting 55 minutes, 4 hours, and 3 hours. In Marshall's case distal pressure was applied without serious consequences, on one occasion for 18 hours, and on another for 19 hours. Vomiting has been found to be a troublesome complication in several cases. Of the successful cases, Murray's is the only one in which the pulsation of the tumour ceased permanently immediately after the operation. In Greenhow and Hulke's case it did not finally disappear till some days after the last application of the tourniquet; and in Durham and Moxon's, although it ceased at the time, it returned in a few hours, and persisted for a month before it finally disappeared. From the above cases, it will be seen that there is abundant evidence of the safety of the *proximal* operation, and sufficient probability of success to justify us in adopting it in every favourable case. Further evidence is required before abandoning *distal* pressure as absolutely useless. In Bryant's fatal case the sac was found to be filled with firm clot, which was considered to have been sufficient, had the patient lived, to have cured the aneurism. In Marshall's case the tumour was thought to be slightly more solid after the operations, but no permanent effect was produced. The distal operation, however, does not seem a very hopeful one. The number and size of the branches coming off from the aorta at its upper part, and the frequency with which the cœliac axis and its large branches are implicated, are very unfavourable circumstances for distal pressure. The anastomosis of the collateral vessels is, moreover, so small compared to the immense interference with the direct circulation, that the only effect of distal pressure must be for many hours greatly to increase the tension in the vessels above.

In performing the operation of compression of the aorta under prolonged anæsthesia, a few points require special attention. The patient should be fed well on the day before the operation. On the day of the operation he should receive fluid nourishment only, and the bowels should be well emptied by means of a copious enema. The tourniquet must be applied with the greatest care immediately above the tumour, and with no more force than is absolutely necessary. If much force be required before the pulsation in the femoral arteries is arrested, it is probable that the pad of the tourniquet is not in the right place, and various attempts must be made till the spot is found where the smallest amount of pressure will control the circulation. It will be found convenient to insert a soft hollow sponge under the pad of the tourniquet, as it then accommodates itself more readily to the parts between it and the spine. During the operation the patient must be watched very carefully, and the tourniquet slackened at once if any symptoms of faintness intervene. Obstinate vomiting may render the continuance of the operation impossible. It is difficult to say whether this is due to pressure on the sympathetic or to the influence of the chloroform. During the application of the tourniquet, it is advisable to have the lower limbs raised in the bed and warmly wrapped in cotton-wool, as marked coldness and serious congestion have usually been noticed after the compression has lasted a short time. If necessary, nutritive enemata and brandy may be administered during the anæsthesia.

## INGUINAL ANEURISM.

An **Iliac** or **Inguinal Aneurism** may arise from the external iliac, or from the common femoral artery; most frequently it springs from the latter, and, taking a direction upwards, pushes the peritoneum before it, and thus encroaches somewhat upon the cavity of the abdomen. The aneurism is commonly of the circumscribed false variety, though sometimes tubular. It rarely, if ever, becomes diffused, for the reason long ago pointed out by Scarpa, that the femoral artery, above the edge of the sartorius muscle, is invested by so dense a sheath, and is so closely bound down to the neighbouring fascia, that, when dilated into an aneurism, it does not readily give way.

SYMPTOMS.—When first noticed, the aneurism is a small, soft, compressible tumour, with pulsation and bruit, and is generally attended by little pain or uneasiness. It rapidly enlarges, however, and may attain a considerable magnitude; being often somewhat lobulated upon the surface, owing to the unequal constriction exercised on it by the fasciæ under which it lies. At the same time, it usually becomes more solid; and the pulsation in it diminishes considerably, or even ceases entirely. As it increases in size, it compresses the saphena and femoral veins, thus giving rise to œdema of the limb; and, by stretching the genito-crural and some of the branches of the anterior crural nerve, it occasions considerable pain in the thigh and leg.

DIAGNOSIS.—The diagnosis of inguinal aneurism is not always so easy as might at first appear. It has most frequently been confounded with abscess in the groin, with carcinomatous tumours in this situation, and with osteo-aneurism. The diagnosis from *abscess* must be made on general principles; but in some instances it appears to be replete with difficulty, as there are not a few cases on record in which aneurisms in this situation have been mistaken and punctured for abscesses, an error that has three times fallen under my own observation, and one which has in every instance proved fatal. The diagnosis of an inguinal aneurism, solidified by the deposition of laminated fibrine, and pulsating but indistinctly, from a *pulsating encephaloid* or *osseous tumour* in the groin, is surrounded by the greatest difficulty, and cannot, I believe, with the means we at present possess, be accomplished with absolute certainty. The fact of the two diseases having in two instances been confounded by two of the most distinguished Surgeons of the day, Stanley and Syme, is sufficient evidence of the difficulty attending their diagnosis.

TREATMENT.—It occasionally happens that inguinal aneurisms, even of a very large size, undergo spontaneous cure, or become consolidated by direct pressure conjoined with constitutional treatment; but these instances are of such rare occurrence, that such a result cannot be relied on in any one case. Compression of the aorta under prolonged anæsthesia has of late years been found so successful, that in no case should a trial of it be omitted when possible (see p. 137). Should it fail, it becomes necessary to tie the vessel leading to the sac. In the majority of instances the tumour, though it may have encroached on the abdomen, will not have reached too high for the external iliac to be ligatured; should it have done so, however, the Surgeon may have to tie the common iliac artery; but in some instances even this may not be practicable, and his choice must lie between the slender chance offered by constitutional treatment, and the fearful alternative of ligaturing the aorta.

**Ligature of the External Iliac Artery.**—There are two modes of tying the external iliac artery—the one originally practised by Abernethy, somewhat modified by Liston; and the other introduced by Sir A. Cooper.

*Abernethy's modified operation* (Fig. 395), on the right side, consists in commencing an incision at a point rather more than two finger-breadths to the inner side of and a little above the anterior superior spine of the ilium, carrying it in a somewhat curved direction, with the convexity of the curve outwards and the concavity looking towards the middle line, to a point that is as nearly as possible opposite to, but about an inch or an inch and a half above, the middle of Poupart's ligament. When the operation is on the left side, the incision should be begun below, and carried upwards between the two points indicated. It is about four inches in length, and, if necessary in fat subjects, may be extended at the upper end. After dividing the skin and superficial fascia, the fibres of the external oblique tendon are carefully cut through. The internal oblique and the transversalis muscles are then divided with great caution, when the transversalis fascia is reached, which is recognised by its dull yellowish-white appearance. A small portion of this membrane, at the lower angle of the wound, where it is thinned and expanded for the passage of the spermatic cord, is now carefully raised with the forceps, and cut through with the blade of the scalpel laid flat. A broad hernia-director is then introduced, and passed underneath it, when it should be laid open upwards and outwards to the full extent of the wound. The whole of the inner side of the wound is next drawn towards the mesial line, the peritoneum being gently separated from its loose areolar connections in the iliac fossa by the Surgeon's fingers; it must be kept out of the way by an assistant, who holds it up with a broad bent copper spatula or a butter-pat. The opening of the transversalis fascia is the most critical part of the operation;

but, if done in the way which I have described, and at the lower angle of the wound, it may be safely accomplished. The artery may now be felt pulsating

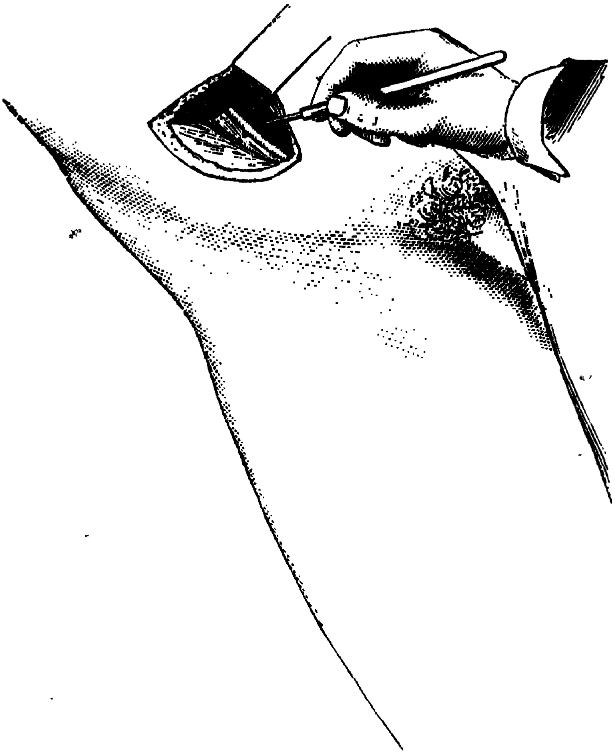


Fig. 395.—Ligature of the External Iliac by Abernethy's Operation, modified.

at the bottom of the wound, covered by a thin fascia and having the vein lying to its inner side, and somewhat behind it. The investing areolar tissue must be scratched through, and the needle passed from the inner side between the vessels, the ligature being then tied in the usual way.

In *Sir A. Cooper's operation*, an incision about three inches in length is made a little above and nearly parallel to Poupart's ligament, beginning above the inner margin of the external abdominal ring, and ending near the anterior superior spine of the ilium. By this incision the tendon of the external oblique is exposed, and must be divided to the full extent of the external wound, when the spermatic cord will be seen passing under the lower edge of the internal oblique and transversalis muscles. Some loose areolar tissue and fascia have now to be scratched through ; and the finger, being passed under the cord, will come into contact with the external iliac artery, close to the spot where the epigastric is given off from it ; the upper side of the incision must now be well raised by a copper spatula, when the vessel will be exposed, covered by an areolar sheath and having the vein to its inner side ; the sheath must be cautiously opened, and the ligature passed from within outwards.

On comparing the two operations, it would appear that the principal disadvantage of Abernethy's is, that it is apt to leave a tendency to hernial protrusion, in consequence of the abdominal wall being much weakened by the free incisions through the muscular planes that are necessary; the great advantage attending it is, that the external iliac may be ligatured at any part of its course, and that, if requisite, the incision may be extended upwards, and the common trunk secured. In Sir A. Cooper's operation, the line of incision lies directly across the course of the epigastric artery, which, as well as the circumflex ilii, if it arise high, and the circumflex vein, which crosses the iliac artery at this point, and is often somewhat funnel-shaped, may be in danger of being wounded. The spermatic cord is likewise somewhat in the way in this operation. Dupuytren actually wounded the epigastric artery in one case; and Houston had much difficulty from the circumflex vein in another instance. This operation had also the disadvantage, that by it it is impossible to prolong the incision upwards so as to deligate any portion of the vessel except that which lies immediately above the crural arch; but the peritoneum is less disturbed than in the other case, and there is less tendency to hernial protrusion afterwards. As a general rule, I think we may conclude that, in cases of spontaneous aneurism, in which it might, from the size of the tumour or the diseased state of the vessels, be found necessary to apply the ligature to a higher point than was intended before the operation commenced, it will be safer to have recourse to Abernethy's plan, modified as above described, as in this way we shall be able to ligature the vessel at any part of its course; whilst in cases of hæmorrhage after amputation, or of traumatic femoral aneurism, in which the artery is not likely to be diseased, recourse should be had to Cooper's operation, more particularly if the patient be thin, and the abdomen flat.

In connection with the ligature of the external iliac artery, there are some practical points that deserve mention. Before the operation, the colon should be emptied by means of an enema, and the pubes shaved. The incision in the abdominal wall must be sufficiently extensive; but, at the same time, it must not be carried too far forwards at its lower angle, lest it implicate the epigastric vessels. These may be roughly stated to lie at first nearly parallel to the course of the external iliac, but soon turn inwards. It should of course never be allowed to implicate the external ring, lest it give rise to a tendency to hernial protrusion. Care should be taken not to wound the peritoneum; for, although two patients in whom this was done by Post and Tait both recovered, yet it is of course a dangerous accident, and should if possible be avoided. The peritoneum must not be torn up more than is absolutely necessary, lest hæmorrhage or subsequent peritonitis occur; and especial care must be taken that the fascia transversalis be properly divided, otherwise the iliac fascia may be stripped up with the peritoneum, and the artery in this way dragged out of its normal situation into the upper and inner angle of the wound, occasioning great embarrassment to the operator, who may not be able to find it. The separation of the peritoneum is much facilitated by the Surgeon holding the outer cut edge of the transversalis fascia tightly in his forceps with one hand, whilst he gently raises the bag of the serous membrane with the other out of the iliac fossa, and separates its areolar connections there. All this must be done with the utmost gentleness and care. Before attempting to pass a ligature round the vessel, the thin fascia covering it must be scratched through; and the areolar connections with the vein, which are very thin and loose, must be separated by means of a director, or the end of the aneurism-needle. The artery must be well cleared, and especial care taken that the genital branch of the genito-crural nerve is not included in the noose. It is better not to use the knife deep in the wound; and, lastly, the sac, if it extend high, must not be weakened by having its peritoneal covering stripped off.

**Results.**—Ligature of the external iliac artery was first practised by Abernethy in 1796. During the following fifty years it was done in at least 100 recorded instances for inguinal aneurism (Norris); of these, seventy-three were cured, and twenty-seven died. In one remarkable case, both external iliacs were ligatured successfully at an interval of eleven months, by Tait. In some few cases also, there was the complication of an aneurism in the ham with that in the groin. Of ninety-two cases in which the aneurism was solely seated in the groin, seventy were cured and twenty-two died. Death resulted from gangrene of the limb in eight, from secondary hæmorrhage in four, from sloughing of the sac in three, from tetanus in three, and from causes of a more general character in four cases.

*Pulsation returned in the sac* in six cases; in some not until several weeks had elapsed after the operation; and in one instance only was this phenomenon followed by death. *Suppuration of the sac* was of frequent occurrence, happening in thirteen instances, doubtless owing to the large size that these tumours are often allowed to attain before being subjected to surgical interference. It is remarkable, however, that in three cases only was this accident fatal; and in two of these three instances the sac had been opened before the operation, on the supposition of its being an abscess. *Secondary hæmorrhage* occurred but in six cases, four of which proved fatal; a very small proportion when compared with what happens in other situations. This must doubtless be attributed in a great measure to the absence of any collateral branches springing from the trunk of the external iliac; the distance between the point ligatured and the epigastric and circumflex ilii arteries affording abundant space for the safe obliteration of the vessel. In one of the fatal cases, pulsation had previously returned in the sac; in the other three the patients died on the seventeenth, the twenty-seventh, and the forty-third days respectively.

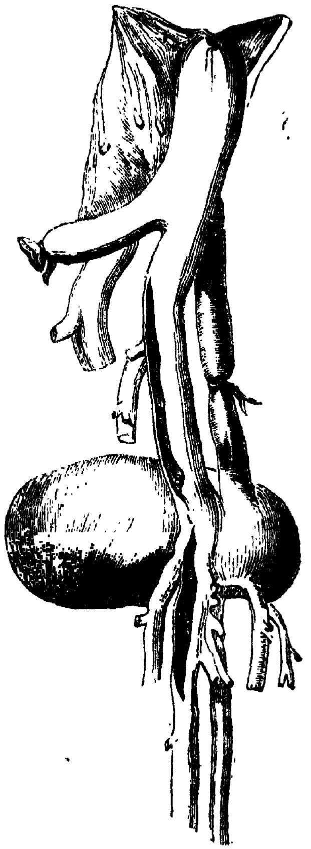


Fig. 396.—Obliteration of Femoral Vein by Inguinal Aneurism.

*Gangrene* of the limb is the most common cause of death after deligation of this vessel. It occurred in nine instances, of which eight proved fatal; one being cured by amputation. The period at which the mortification supervened varied from the third to the fourth week. The principal cause of this gangrene is narrowing or obliteration of the neighbouring venous trunk, by pressure of the tumour. In the accompanying woodcut (Fig. 396) this is well illustrated; the vein opposite the aneurism being completely closed.

It is a very remarkable circumstance in the history of this operation, that four deaths resulted from *tetanus*. This sequence of this particular operation it is difficult to account for, as it is a most unusual occurrence after the ligature of arteries, and is equally rare after wounds of the abdominal wall in other operations, as for hernia. The only probable explanation that offers itself is that in these cases the genito-crural nerve, or its genital branch, may have been unduly irritated by or implicated in the ligature.

The ligature of the external iliac for *aneurismal varix in the groin* affords a striking contrast with that for spontaneous aneurism ; the four cases recorded all proving fatal, two dying of gangrene, and two of hæmorrhage. In these cases Guthrie has recommended that the tumour should be laid open, and the artery ligatured above and below the aperture in it. During the operation the artery may be readily commanded above the seat of disease by the application of the abdominal tourniquet, either to the aorta or to the common iliac at the brim of the pelvis.

Aneurism occasionally takes place *in the groin and ham of the same side* ; here the ligature of the external iliac will cure both diseases. Of four cases in which this complication occurred, the operation was successful in three ; one patient dying of gangrene, and in him the popliteal aneurism was on the point of bursting at the time of the operation. In two of the three cases that recovered, pulsation returned in the inguinal aneurism, but disappeared after a time.

**Ligature of the Common Iliac.**—This artery was first tied by Gibson, in a case of gun-shot injury, the patient dying of peritonitis and secondary hæmorrhage on the thirteenth day. The great American Surgeon, Mott, was the first who tied it for aneurism, the patient making a good recovery. If the aneurism in the groin extend so high that there is not sufficient space for the exposure and ligature of the external iliac artery, it becomes necessary to tie the common trunk. This may be done by extending the incision that serves for the ligature of the external iliac upwards and slightly inwards towards the umbilicus, to an extent corresponding to the degree of obesity of the patient, so that it assumes a somewhat semilunar form. Or a semilunar incision may be made from the end of the last rib on a point about two or three inches above the umbilicus, and carried downwards and inwards to a corresponding extent below it. The incision is then successively carried through the different planes of muscular fibre with great caution and on a grooved director, until the transversalis fascia is exposed ; this must be carefully opened and freely divided, so as to expose the peritoneum, which now comes bulging into the wound, pressing forward with its contents. This must be held aside, drawn upwards by the fingers of an assistant, and gently stripped from the iliac fossa by the Surgeon carefully insinuating his hand beneath it. When he arrives at the brim of the pelvis, he will readily be conducted to the external iliac artery, which guides him to the parent trunk. The ligature must then be passed round the artery from within outwards, a slight scratch having been made through the fascia covering the vessel by means of the finger-nail, by which it may also be separated from the accompanying vein.

In planning the incision for the ligature of this artery, care should be taken that it be not carried too low down or too far forwards ; nothing can be gained by doing so, and there is besides the additional risk of the circumflex ilii or epigastric being wounded, as happened to Mott; and, as these are the principal agents in the anastomosing circulation, their injury is a serious accident. Should any muscular branches bleed, they had better be ligatured, so as not to obscure the after-steps of the operation. The fascia transversalis should be opened at the lower part of the wound, where it is thinned for the passage of the spermatic cord, by pinching up a portion of it with the forceps, and dividing it carefully with the edge of the knife laid horizontally; it will be found to be much thicker and denser at the upper and outer part of the wound than in this situation. When the peritoneum is well drawn upwards to the mesial line by the assistant's fingers or by copper spatulæ, the ureter, which crosses the artery in this situation, will be carried up with it, so as not to be seen at all. In this stage of the operation, the patient should be turned on his sound side, in order to prevent the intestines from falling over and pressing the peritoneum into the wound.

The vein usually comes into view; sometimes turgid and overlapping the artery. The veins on the two sides differ in their relation to the arteries. On the right side the vein is at first beneath, and then to the outer side. The left vein lies to the inner side of the left artery, and then passes beneath the right common iliac artery to join the right vein. By means of the finger-nail and the blunt end of the aneurism-needle, the vein may be gently separated from the artery to an extent sufficient for the passage of the ligature.

In determining the length of the incision, and calculating the point at which he would expect to meet with and ligature the artery, it is a matter of the very first importance for the Surgeon to remember the *different bearings of the parts in the neighbourhood of the vessels*, and the *relative frequency with which the origin and termination of the artery corresponds with certain fixed points* that may readily be detected.

The points of importance are the relations of the vessels to the lumbar vertebræ, to the crest of the ilium, and to the umbilicus. The ordinary place of division of the abdominal aorta is on the body of the fourth lumbar vertebra, or on the invertebral disk below it; according to Quain, this was the case in three-fourths of the bodies he examined, or in 156 out of 196. In regard to the relations between the situation of the bifurcation of the aorta and the crest of the ilium, we find it, according to the same anatomist, to have ranged in about four-fifths of the cases about half an inch above and below the level of the highest point of this part of the bone. With reference to the umbilicus, no definite rule can be laid down; but in general terms it may be stated that the bifurcation of the aorta is a little to its left. As a general rule, that given by Hargrave is perhaps sufficiently good for ordinary purposes. If a point be taken about half or three-quarters of an inch below and a little to the left of the umbilicus, and a line be drawn on each side from this point to the centre of Poupart's ligament, we obtain about the direction of the common and external iliac arteries. On dividing these lines into three equal parts, the upper third will correspond to the primitive trunk, and the lower two-thirds to the external iliac, and the junction of the upper with the middle third to the bifurcation of the common iliac artery.

The point of division of the common iliac artery is. in the majority of cases, between the middle of the fifth lumbar vertebra and the middle of the sacrum, both points inclusive; and if it be not in this situation the division will probably be lower down. The length of the vessel varies greatly; according to Quain, in five-sevenths of the cases it ranged between one-and-a-half and three inches.

**Results.**—Writing in 1852, I stated that when we look at the depth at which this artery is situated, its great size, and proximity to the centre of the circulation, and consider the force with which the blood rushes through it, we cannot but be struck with the success which has attended its ligature. Of 17 cases in which it had been tied, 8 were cured, and 9 died; in 11 of the cases the ligature was applied for aneurism, and of these 7 recovered. The 4 that died perished rather from the magnitude and extent of the disease than from the effects of the operation; and it is remarkable, as showing the power of the anastomoses in maintaining the vitality of parts, that in no instance did gangrene ensue. Since this period the operation has been performed many times, but with much less satisfactory results. Stephen Smith, of New York, published the statistics of this operation in 1860, giving the details of 32 cases; of these, he says, 25 died and only 7 recovered. I think the numbers should be 24 and 8; as in one case (Bushe's), the patient (an infant) died two months after the operation, the ligature having separated and the artery being occluded and thus the deligation having succeeded. Gurlt of Berlin, in reproducing Smith's tables, adds 2 cases, both fatal. To these must also be added a fatal case by Dugas, of Charleston, and five in which the operation has, within the last few years, been performed in this country; once by Bickersteth of Liverpool; once by Syme, in a remarkable case of iliac aneurism, in which that distinguished Surgeon laid open the sac and tied the arteries (the common, external, and internal iliacs) opening into it—both successful; once by Hargrave of Dublin, whose patient died on the seventy-third day after the operation, of gangrene of the foot and profuse discharge from the wound; and once by Maunder, the patient, a man forty years of age, dying on the sixth day from gangrene of the lower extremity; by Morrant Baker in a youth of 17, for hæmorrhage from a branch of the internal iliac, consequent on ulceration produced by sacro-iliac disease—fatal on the day following the operation. These cases increase the total number to 40, of which 10 recovered and 30 died; in 9 of the cases the peritoneum was wounded, and of these 8 proved fatal. Of 14 cases in which this vessel was tied for hæmorrhage, 13 proved fatal; the majority of the recoveries took place after operation for aneurism—which constituted about half of the cases.

**Treatment by Compression** has been successfully applied to aneurism of the iliac arteries. The compression must be applied to the aorta by means of Lister's tourniquet (Fig. 65), as in the treatment of aneurism of the abdominal aorta (p. 137). A considerable number of cases have now been cured by these means. They have already been referred to when treating generally of the subject of compression of the arteries for cure of aneurism. Murray insists on the importance of complete arrest of the circulation in these cases, so that not the slightest current of blood should pass through the sac. One of his cases was cured in three-quarters of an hour. One of Heath's (of Newcastle) consolidated in twenty minutes. Lawson in one case applied two tourniquets—one to the abdominal aorta, the other to the femoral below the sac.

The abdominal tourniquet had to be removed at the end of twenty minutes, owing to collapse and vomiting; the femoral one was maintained. When the abdominal compressor was removed the pulsations had already diminished, and at the end of four hours they ceased; the patient making a good recovery. Holmes has collected 10 cases of iliac or ilio-femoral aneurism, treated by this method; and of these, 7 were cured, and in 3 the treatment failed. These 3 afterwards underwent ligature of the artery leading to the sac—in one case the abdominal aorta—and all died. These statistics clearly show that no operative treatment is justifiable, except after the failure of compression.

**Ligature of the Aorta.**—It is impossible not to contemplate with admiration the man whose mind was the first to conceive, and whose hand was the first to carry out, the determination to apply a ligature to the abdominal aorta; and who, guided by pathological observation and physiological experiment, to arrest at once the circulation through the main channel of supply to the lower half of the body, trusting to the collateral circulation for the maintenance of the vitality of the parts thus suddenly deprived of blood. Sir A. Cooper was the first to place a ligature on the aorta, in 1817. Since that period the operation has been six times performed for aneurism; viz., by James, of Exeter; by Murray, at the Cape of Good Hope; by Monteiro, at Rio Janeiro; by South, of London; by McGuire, of Richmond, U.S.; by Stokes, of Dublin; and once, in circumstances which will be presently described, by Czerny, of Vienna.

TABLE OF CASES OF LIGATURE OF ABDOMINAL AORTA FOR ANEURISMS.

| SURGEON. | SEX. | AGE. | DATE. | NATURE OF ANEURISM. | OPERATIONS. | RESULTS. |
|---|---|---|---|---|---|---|
| 1. SIR A. COOPER. | M. | 38 | 1817 | Diffused Inguinal | Incision through Peritoneum. | Death in 40 hours. |
| 2. JAMES. | M. | 44 | 1829 | External Iliac. | Distal ligature first: Peritoneum opened. | Death in a few hours. |
| 3. MURRAY. | M. |  | 1834 | Inguinal. | Aorta tied behind Peritoneum. | Death in 24 hours. |
| 4. MONTEIRO. | M. |  | 1842 | Diffused Inguinal | Aorta tied behind Peritoneum. | Death on 10th day. |
| 5. SOUTH. | M. | 28 | 1856 | Common Iliac. | Aorta tied behind Peritoneum. | Death in 43 hours. |
| 6. MCGUIRE. | M. | 30 | 1868 | Lower part of Aorta, both Common Iliacs, and Left External Iliac. | Aorta tied behind Peritoneum. | Death in 12 hours. |
| 7. W. STOKES. | M. | 50 | 1869 | Iliac. | Aorta tied behind Peritoneum. | Death in 13 hours. |

In Sir A. Cooper's case, the inguinal aneurism had burst, and the aorta was tied about three-quarters of an inch above its bifurcation, by making an incision three inches in length through the abdomen, a little to the left of the umbilicus, the fingers being passed between the convolutions of the intestines, and the peritoneum covering the artery being scratched through. The patient survived forty hours. James ligatured the aorta much in the same way as Sir A. Cooper did, in a case in which he had previously employed the distal operation for an inguinal aneurism; but without success, the patient speedily dying. Murray ligatured the vessel by making an incision on the left side, in front of the projecting end of the tenth rib, and carrying it downwards for six inches to the anterior superior spine of the ilium. The parts were then carefully divided to the peritoneum, which was separated from the iliac fossa and the psoas muscle, when, with great difficulty, and by scratching with the end of an elevator and the finger-nails, room was made for the passage of the ligature round the artery, which was tied three or four lines above its bifurcation. The patient died in twenty-three hours. The most interesting case on record is that by Monteiro, who tied the aorta for a large false aneurism on the lower and right side of the abdomen; here the incision was made much as in Murray's case, and the artery ligatured with great difficulty. The patient lived till the tenth day, when he died of secondary hæmorrhage. In South's case, the aorta was tied behind the peritoneum by an incision on the left side of the abdomen. The patient died in forty-three hours. McGuire's patient had an aneurismal tumour of the size of a goose's egg in the left iliac region. Digital pressure near the umbilicus was attempted, but could not be done. The operator's intention was at first to tie the left common iliac artery; but, finding the disease more extensive than he expected, he enlarged the incision and tied the aorta. The sac burst during the manipulation necessary to reach the aorta, and about a pint of blood was lost. The patient died in eleven hours. Stokes compressed the aorta with a silver wire passed round it in the way of a ligature. He made a crescentic incision five-and-a-half inches in length in the left side of the abdomen, extending from an inch below the tenth rib to the middle of Poupart's ligament. The abdominal muscles and fascia transversalis were then incised, and the peritoneum exposed and drawn out of the iliac fossa. It was accidentally, but only slightly wounded. The patient being turned on his right side, the arteries and aneurism were exposed, and the wire passed by means of an aneurism-needle round the aorta immediately above its bifurcation. The patient died in twelve hours. Perhaps the most interesting point in this remarkable case is the fact of the pulsation returning in the left (sound) femoral artery nine hours after the operation; showing how rapidly the collateral circulation can be re-established. Czerny's case scarcely belongs to the present category, but may be mentioned here. The patient was a French soldier, the upper part of whose thigh had been shattered by a ball during the Franco-German war. Secondary hæmorrhage occurring, Czerny tied the common femoral, and also the superficial femoral below the origin of the profunda. This arrested the hæmorrhage for a time; but in six days it recurred. Czerny then tied the common iliac; but, as the hæmorrhage continued, he thought that he had tied the external iliac, and proceeded to apply another ligature—which he placed by mistake on the aorta. The patient survived twenty-six hours. In this case too, twenty-two hours after the operation, the injured limb was cold and as if dead, while the opposite limb was warm, and retained sensation and motion.

In this operation, there are not only all the dangers attendant upon the ligature of arteries of the first magnitude, but also the risk of producing fatal peritonitis, whether the abdomen be cut through, or the vessel sought for by stripping up the peritoneum from the iliac fossa; and it appears to me that a patient suffering from so large an inguinal aneurism as to justify ligature of the aorta, would have a better chance of recovery, or rather of prolongation of life, by the adoption of proper constitutional treatment, together with pressure upon the tumour and the distal ligature or compression of the artery. Lister's aortic compressor might be applied in such cases, so as to moderate the flow of blood.

Aneurism of the Internal Iliac and its Branches.—Aneurism of the *Trunk of the Internal Iliac Artery* is extremely rare. The only case with which I am acquainted is one related by Sandifort. The three principal branches of this artery—the *Gluteal*, the *Sciatic*, and the *Pudic*—have all occasionally, though rarely, been found affected by this disease. Of these branches, the gluteal has been most frequently found aneurismal, the sciatic next, and the pudic least frequently; indeed, I am acquainted with only one instance of aneurism of this vessel. It is the preparation 1701 in the Museum of the College of Surgeons; and it exhibits an aneurism of the trunk of the pudic nearly an inch in diameter, full of fibrinous laminæ.

**Aneurisms of the Gluteal and Sciatic Arteries** may be either traumatic or spontaneous.

Fischer of Hanover has published with comments, in the *Archiv fur Klinische Chirurgie*, the records of thirty-five cases of gluteal and sciatic aneurism: to which must be added a case of gluteal aneurism described by Gallozzi of Naples and one by Bickersteth of Liverpool. In twenty-seven of the cases the aneurism was distinctly gluteal; and in six distinctly sciatic. Thirteen of the gluteal aneurisms, and two of the sciatic, were of traumatic origin; fourteen gluteal and four sciatic aneurisms were spontaneous. The gluteal aneurism has been generally found situated at the upper part of the great sciatic notch; but may extend over a large portion of the buttocks. Sciatic aneurism lies more deeply; and a portion of the sac may be within the pelvis. The size of these aneurisms varies from a slight swelling to a tumour as large as a child's head. In almost all the recorded cases there has been strong pulsation, isochronous with the heart's beat; and whirring and buzzing murmurs are heard on auscultation. There is almost always pain in the tumour itself and in the course of the sciatic nerve, which may be followed by paralysis of the parts supplied by it.

The affections with which these aneurisms are most likely to be confounded are abscesses, medullary tumours, cysts, and sciatic hernia. The diagnosis is sometimes difficult: thus Guthrie ligatured the common iliac artery for a large pulsating tumour in the gluteal region, which presented all the characters of aneurism, but which proved, on the death of the patient eight months after the operation, to be a pure encephaloid tumour.

Gluteal aneurisms have on several occasions been opened by mistake for abscesses. According to Holmes, this accident has most frequently happened when the aneurism has been more or less diffused, and in such cases he suggests that the aspirator should be used to render the diagnosis certain.

In the *Treatment*, various methods have been employed. *The sac has been laid open* and the gluteal artery tied in five cases, all of which recovered. In another instance, after laying open the sac, the aneurism (gluteal) was found to extend into the pelvis; and the internal iliac artery was tied, with a fatal result. *Ligature of the internal iliac artery* has been performed in eleven cases, six of which recovered. *The common iliac artery* has been tied in three cases, all of which proved fatal. *Injection of the perchloride of iron* has been used in six cases; four recovered, one died, and in one the result is not known. *Ligature of the sciatic artery* without opening the sac has been performed in two cases, one of which recovered. Spontaneous recovery is reported to have occurred in one case.

**Ligature of the Internal Iliac.**—This vessel was ligatured for the first time in 1812. The operation was performed by Stevens of St. Croix, on a negress who suffered from an aneurism of the nates, supposed to be of the gluteal artery, but found after death three years subsequently to take its origin from the sciatic. Stevens in this case made an incision five inches long on the left side of the abdomen, carefully dissected through the parietes, separated the peritoneum from the iliac fossa, turned it on one side, together with the ureter, and passed a ligature round the artery without much difficulty. Since that time the operation has been done nineteen times; in six cases with success, by Arndt, White, Mott (who accidentally wounded the peritoneum), Syme, Morton, and Gallozzi; in thirteen cases unsuccessfully, by Atkinson of York (whose patient died on the nineteenth day, of secondary hæmorrhage), by Bigelow, Torracchi, Cianflone, Porta, Landi, Kimball, Altmüller, Thomas, J. K. Rodgers, and Higginson; and twice by the Surgeons in the American Civil War.

The success that has hitherto attended this operation is certainly remarkable, when we take into consideration the depth at which the artery is situated and its great size; it must, I think, be accounted for by the fact that, although in these cases the patient runs the ordinary risks attendant on the ligature of the larger pelvic arteries from the exposure and handling of the peritoneum, yet he is saved the danger resulting from the supervention of gangrene; the anastomosis between its branches and that of the neighbouring vessels being so free, and the course traversed by the blood so short, that no difficulty can arise in the maintenance of the collateral circulation.

The steps of the operation necessary for the exposure of the internal iliac artery are precisely analogous to those requisite for the ligature of the common trunk. When the vessel is reached, it must be remembered that both the external and internal iliac veins are in close relation to it; the one being to its outer side, the other behind it. As these vessels are large, and their coats thin, it is necessary that they should be separated by the finger-nail, or the blunt end of an aneurism-needle, before the ligature is passed round the artery; care must also be taken not to put the vessel too much on the stretch in applying the ligature, lest the ilio-lumbar artery be ruptured. As the length of the artery varies much, usually ranging between one and two inches, and as when it is short it has a tendency to be placed deeply in the pelvis, it would, I think, be more prudent, and occasion less chance of secondary hæmorrhage, for the Surgeon to ligature the common trunk.

### FEMORAL AND POPLITEAL ANEURISMS.

We have, in the preceding section, considered aneurisms affecting the groin, which are by no means of very unfrequent occurrence. Aneurisms of the thigh are, however, much less frequently met with ; but those in the ham are very commonly encountered. Thus, out of 551 cases of aneurism recorded in the British medical journals of the present century, Crisp has found that 137 affected the popliteal, and only 66 the femoral artery. Of these 66, 45 were situated either in the groin or upper part of the thigh, and 21 only were truly femoral or femoro-popliteal. The reason of this difference in the frequency of the occurrence of aneurism in different parts of the vessel, may be accounted for by attention to its anatomical relations. In looking at the main artery of the lower extremity, in its course from Poupart's ligament to where it terminates in the anterior and posterior tibials, we see that it may be divided in relation to the muscular masses that surround it, into three principal portions : 1. That which is situated between Poupart's ligament and the anterior margin of the sartorius, and which may be considered *inguinal ;* 2. That which intervenes between this point and the aperture in the adductor tendon, and which may be considered *femoral;* and, 3. That division of the vessel which corresponds to the ham, and which may be considered *popliteal.* Of these three divisions, the first and last are comparatively superficial, and, being unsupported by muscle, readily expand ; while the central portion of the artery is closely surrounded on all sides by muscular masses, and is very unlikely to be dilated into an aneurismal tumour. We also find that the inguinal portion of the vessel is closely and firmly invested by a dense and resistant fibro-areolar sheath, and is well supported by the fascia lata ; whilst in the popliteal space the artery is merely surrounded by the ordinary areolar sheath, and receives no aponeurotic support. This difference in the connections of these two parts of the vessel may, to a certain extent, explain the greater frequency of aneurism in the ham than in the upper part of the thigh.

ANEURISM OF THE DEEP FEMORAL ARTERY is of extremely rare occurrence ; indeed, I am acquainted with five cases only. One of these occurred in a young man under my care in University College Hospital in 1870. There was a large tumour at the upper part of the thigh, over which lay the superficial femoral artery, pulsating freely. The disease was cured by compression of the common femoral artery, hydrate of chloral being given to relieve pain. Another case is recorded by Bryant as having occurred in the practice of Cock at Guy's Hospital. The aneurism was situated at the origin of the deep femoral artery ; the external iliac was tied, but the patient died nine weeks after the operation. Fig. 397 is taken from a patient who died of pneumonia shortly after admission into University College Hospital. On examination after death, a large tumour of

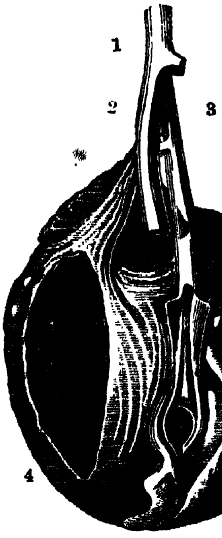


Fig. 397.—Aneurism of Deep Femoral Artery.
1. Common Femoral.
2. Superficial Femoral.
3. Deep Femoral.
4. Aneurism, cut open

the thigh, which had not been very closely examined during life, proved to be a circumscribed aneurism of the deep femoral artery. Two cases are recorded by P. Marshall and J. Watson. In the case which was under my care in the Hospital, the disease was recognised by the following signs, which are characteristic of it. 1. A large tumour extended from three inches below Poupart's ligament to the middle of the thigh, raising and slightly separating the adductor muscles and the rectus femoris. 2. All the ordinary aneurismal signs were present in this tumour—the most marked being a peculiarly loud and harsh bruit, and a dry forcible thrill. 3. The superficial femoral artery could be felt running over the anterior and inner aspect of the tumour, but clear of, and distinct from it. 4. The pulsation in the popliteal and its divisions was strong and perfect. 5. All the aneurismal signs ceased on compressing the common femoral artery, and returned on removing the pressure.

The only disease with which an aneurism of the deep femoral artery can readily be confounded is pulsating malignant tumour of the femur. The diagnosis from this must be left to the surgical tact of the practitioner.

In the *Treatment* of these aneurisms, the Surgeon has the choice of three methods; viz., compression in the groin, or ligature of the external iliac, or of the common femoral. If the common femoral ever should be ligatured for aneurism, this appears to me to be the case best suited for it. But the choice between the ligature of this artery or of the external iliac must in a great measure depend upon the Surgeon's judgment as to the relative expediency of either operation, and on the height to which the aneurism extends up the groin. But neither artery should be ligatured until compression has been fairly tried and has failed. This may be done digitally or by Carte's instrument, where the artery passes over the brim of the pelvis. It is especially likely to succeed in aneurism of the profunda, owing to the shortness of the trunk and the way in which it breaks up into many anastomosing branches. Hence there is not a free current of blood passing from one large vessel of entry to another of exit, but, as it is broken up and has to filter out through a number of minor vessels, its coagulation may readily be brought about. In the case treated by me, compression effected a cure in twenty-four hours, though the aneurism was very large and active.

ANEURISMS OF THE SUPERFICIAL FEMORAL AND POPLITEAL ARTERIES.—These commonly occur about the middle period of life, and are almost invariably met with in males, being at least twenty times more frequent in them than in women. Both sides are affected with equal frequency, and occasionally at the same time. According to Crisp, sailors would appear to be more liable to this variety of the disease than any other class. These aneurisms are most frequently sacculated; in the ham they are always so, but in the thigh they are sometimes tubular.

*Symptoms.*—The symptoms of **Femoral Aneurism** present nothing peculiar; the tumour usually enlarging with considerable rapidity, with all the characteristic signs of the disease, and assuming a pretty regular ovoid shape. **Popliteal Aneurism** usually commences with stiffness and a good deal of pain about the ham and knee, which I have more than once seen mistaken for rheumatism; there is also a difficulty in straightening the limb, which is generally kept semi-flexed. The tumour increases usually with great rapidity, and has a great tendency to become diffused; these conditions will, however, materially depend on the side of the artery from which it springs. When it arises from the anterior aspect, next the bone, it increases slowly, being compressed by the firm structures before it. In this case, however, there is the great danger that, by its pressure upon the bones and knee, it may give rise to caries and destruction of the joint. When it springs from the posterior part of the artery, where it is uncompressed, it increases rapidly, and may speedily diffuse itself. The diffusion of an aneurism in this situation may take place in two directions. If it be femoro-popliteal, it may give way into the general areolar tissue of the thigh, the blood diffusing itself as high perhaps as Scarpa's triangle. When it is confined to the ham, it may either give way under the integuments, and into the superficial structures of the limb, or else under the deep fascia of the leg, where it will compress the posterior tibial nerve and artery. In all cases, the diffusion of popliteal aneurism is likely to be followed by gangrene.

*Diagnosis.*—The diagnosis of popliteal aneurism has to be made from chronic abscess, from bursal enlargements, and from solid tumours. In distinguishing it from *chronic abscess,* no serious difficulty can well be experienced; but it may happen that, when an aneurism has suppurated, considerable difficulty arises in determining its true nature; whether it be merely an abscess or not. On such cases as these, the state of the circulation in the lower part of the limb will throw much light. *Bursal tumours,* often of large size and multilocular, are not unfrequently met with in the ham; but I have never found any great difficulty in determining their true nature, their elasticity and roundness, together with their mobility and want of pulsation, being sufficiently indicative of their character. The most serious diagnostic difficulty may arise from confounding solidified aneurisms of the ham with *solid tumours,* of a sarcomatous character, springing from the tibia and femur; and I have known one case of aneurism in this condition, in which amputation was performed on the supposition of its being a solid tumour (Fig. 359).

*Treatment.*—The treatment of femoral and popliteal aneurism may be conducted either by compression or by ligature of the vessel leading to the sac. As a general rule, for the reasons already stated, compression should be employed in preference to the ligature; but yet cases may arise when, from the failure of compression, or for other reasons, it may be necessary to ligature the femoral artery.

The *Treatment by Compression* is peculiarly applicable to these aneurisms, and indeed it is to them that it has chiefly been employed. I need, therefore, say nothing special about it here, but would refer the reader to Chapter XLIII., page 51, for a description of the subject.

*Flexion* of the knee, which may be considered a modification of compression, is also applicable to these cases, either alone or in combination with compression of the main trunk. It is peculiarly applicable in those cases in which the aneurism is well in the ham (see page 61).

**Ligature of the Common Femoral.**—In looking at the femoral artery, it might at first be supposed that the common trunk, situated superficially between the inferior edge of Poupart's ligament and the origin of the deep femoral, would be the most convenient situation for the application of the ligature; but experience has shown that deligation of the vessel here is by no means a successful operation when practised for aneurism. It has been attended by better results when done for the arrest of secondary hæmorrhage from stumps and other traumatic conditions. This arises from the shortness of the trunk rendering it necessary to tie the artery in close proximity to the collateral branch that will constitute the most direct and immediate agent in the anastomosing supply,—viz., the deep femoral, so that the internal coagulum would not readily form. In addition to this, a number of small inguinal branches, such as the superficial epigastric and circumflex ilii, the superficial and deep external pudic, and very commonly one of the circumflex arteries of the thigh, more especially the internal, arise from the common trunk in its short course; and these vessels, though small in size, constitute a source of great embarrassment to the Surgeon during the operation; for, if wounded near their origin, they bleed most furiously, and are a cause of considerable danger afterwards, by interfering with the proper plugging of the vessel. The ligature of the common femoral has, however, several advocates, more particularly in Ireland, where the operation has of late years been done nine times, for wound and aneurism, with six recoveries and three deaths. The successful cases were as follows: Porter, sen., three; G. H. Porter, one; Smyly, one; Macnamara, one. The vessel may be reached either by a vertical or a transverse incision.

The statistics of this operation, *when performed for aneurism*, are by no means favourable. Secondary hæmorrhage has been a frequent and fatal occurrence, in several cases requiring ligature of the external iliac for its arrest. I do not, therefore, think that it is advisable for the cure of aneurism to have recourse to this operation in preference to the ligature of the external iliac; and it may be laid down as a rule in surgery, that in all those cases of aneurism that are situated above the middle of the thigh, in which compression has failed and sufficient space does not intervene between the origin of the deep femoral and the upper part of the sac for the application of a ligature to the superficial femoral, the external iliac should be tied.

**Ligature of the Superficial Femoral.**—The superficial femoral artery, in its course from the origin of the deep femoral to the aperture in the tendon of the adductor, is divided by the crossing of the sartorius muscle into two portions of unequal length, which have different relations to neighbouring structures. The upper division of the artery, which lies above the anterior margin of the muscle, is of most interest to the Surgeon, as it is in this part of its course that it is invariably ligatured in cases of aneurism. It is true that John Hunter, in the operation which he introduced for popliteal aneurism, exposed and tied the vessel in the middle third of the thigh; but his example has not been followed by modern Surgeons, on account of the far greater difficulty in reaching the vessel here than in the first part of its course. The superficial femoral, where it lies in Scarpa's triangle, being merely covered by the common integument, the superficial fascia and the fascia lata may be reached by as simple an operation as any that the Surgeon has to perform for the ligature of the larger vessels. The line to the artery is taken as follows. The Surgeon marks a point exactly midway between the anterior superior spine of the ilium and the symphysis pubis. From this he draws a line directly downwards in the axis of the limb, which, if continued, would fall a little to the inner side of the middle of the patella. The guide to the vessel is the inner border of the sartorius muscle. The point of selection for the application of the ligature is that where the sheath of the vessels is crossed by this muscle at the apex of Scarpa's triangle.

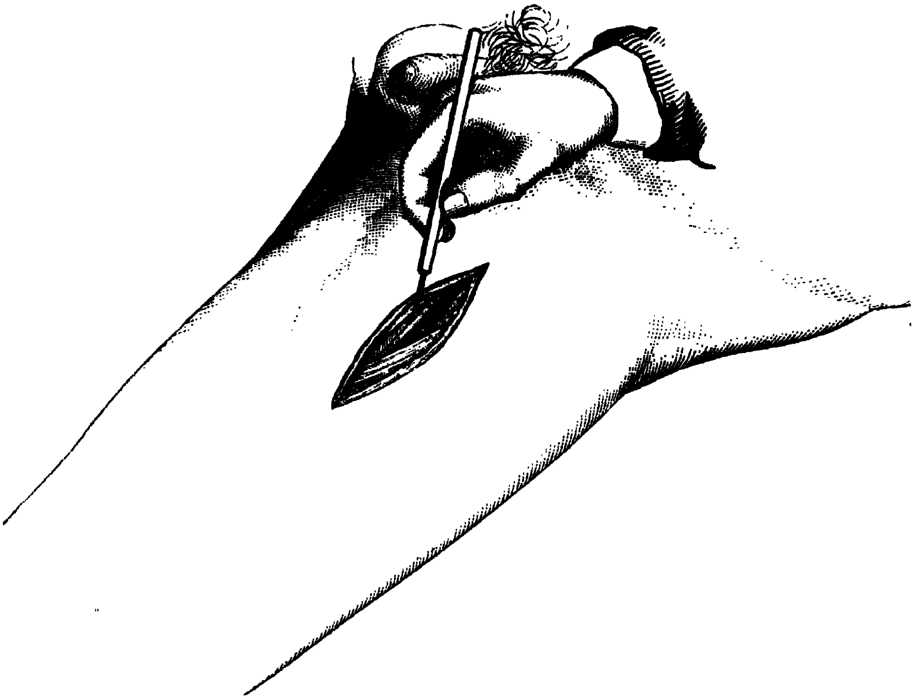


Fig. 398.—Ligature of the Superficial Femoral Artery.

The operation is performed as follows (Figs. 398, 399). An incision is made in the line above indicated, beginning two-and-a-half or three inches below Poupart's ligament, and carried directly downwards for three-and-a-half or four inches. The skin and superficial fascia having been divided, the fascia lata, which is here very thin, is exposed and opened to the same extent as the incision in the integuments; the inner margin of the sartorius now comes into view, and immediately to the inner side of, and perhaps slightly overlapped by this, is the sheath of the vessels; this must now be cautiously opened, the long saphenous nerve being respected, and the aneurism-needle unarmed passed between the artery and vein, in close contact with the former from within outwards, at least four inches below Poupart's ligament; it should then be threaded and withdrawn, and the ligature tied. The edges of the wound must now be brought into contact by a couple of stitches and two strips of plaster; the limb being semi-flexed, somewhat raised, laid on its outer side, and wrapped in soft flannel or cotton wadding. The severe pain which is usually complained of about the knee after the tightening of the ligature may best be relieved by a full dose of opium.

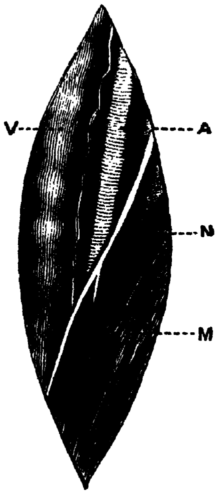


Fig. 399.—Diagram of Left Superficial Femoral Artery at apex of Scarpa's Triangle. A. Femoral Artery. V. Femoral vein. N. Saphena nerve. M. Sartorius muscle drawn to the outer side.

In this operation, there are several points of considerable importance that require special attention. 1. The incision should be made directly in the axis of the limb, and especial care taken not to incline it inwards in the direction of the sartorius. 2. The edge of the sartorius should be exposed to a limited extent, as the surest guide to the artery. 3. In cutting down upon the artery, the saphenous vein, or any parallel branch, should if possible be avoided. 4. After the sheath has been opened, it will sometimes be found that a rather large muscular branch is given off from the artery at about the part where it was intended to ligature it; if so, this must be carefully avoided, as well as any small veins that cross the main trunk in this situation. 5. The ligature should be applied about four inches below Poupart's ligament, so that sufficient space may intervene between the origin of the deep femoral, which is usually from one or two inches below the crural arch, and the point deligated, to admit of the formation of a proper coagulum in the vessel. It has, indeed, happened that the ligature has been placed within three-quarters of an inch of the origin of the deep femoral, without any injurious consequences resulting. The proper point, however, for the deligation of the artery is that indicated, which is usually the very spot at which the sartorius crosses it; though, if this muscle be very broad, it may be necessary to draw it to the outer side, and tie the vessel below it. 6. The greatest care must be taken not to wound the femoral vein, which lies behind and somewhat to the inner side of the artery. It is best avoided by passing the needle from within outwards between the two vessels; the inner side of the sheath being at the same time put upon the stretch by drawing upon it with a pair of forceps. In passing the needle, its end should be kept very close to the artery, and made to circle round it. The vein is generally perforated by dipping the needle too deeply and losing the contact between it and the artery. After the needle has been brought up on the outer side of the artery, a small portion of the sheath will sometimes be found to be pushed up by it; this must be divided by being carefully touched with the point of the scalpel, when the needle may be carried round the vessel.

**Results.**—Ligature of the femoral artery for popliteal aneurism is an operation that has been so frequently performed, that Surgeons seldom think of recording cases of this description, unless they present complications or sequelæ of unusual interest or severity; hence, but little importance can be attached to any statistical deductions from reported cases as to the fatality of this operation, although they may serve as a rough estimate of the proportion maintained between the different accidents, such as hæmorrhage, gangrene, &c., that follow it. That the ligature of the femoral artery is attended with more success than that of any of the other large trunks, can admit of no doubt. This is not only in accordance with the general experience of Surgeons, but is confirmed by the statistics of published cases, even without making allowance for the probability of more of the unsuccessful than successful having been recorded. Thus of 110 instances, collected by Crisp, in which the femoral artery had been ligatured for popliteal aneurism, only twelve are reported to have died; amongst these, four deaths were caused by secondary hæmorrhage, three by gangrene, and the others by phlebitis, tetanus, chest-disease, &c. Higher rates of mortality are, however, given by other authors; thus, Norris states that nearly one in four die after this operation; Hutchinson finds that of thirty-three cases operated on in London, ten were fatal, five deaths resulting from gangrene. Holmes's statistics, which are extremely valuable as being collected directly from hospitals and not from published cases, show very favourable results. Of eighty-seven cases in which the operation was performed for femoral or popliteal aneurism, thirteen died, and in three the operation failed to cure the disease. Gangrene occurred twice, and suppuration of the sac not once. Of the deaths, one was from small-pox, two from wound of the vein and phlebitis, three from pyæmia, one from gangrene and amputation, one from disease of the kidneys, and the rest from various other causes.

**Accidents.—Wound of the Femoral Vein** is without doubt the most serious accident that can happen in the operation for ligature of the superficial femoral artery, and is one of which there is especial risk when recourse is had to this operation for aneurism; as in this disease the fine areolar tissue which naturally connects the two vessels often becomes thickened and indurated, in consequence of inflammatory action having extended upwards from the sac to the sheath of the vessels. It is best avoided by passing the needle in the way that has been already recommended, from within outwards, and rotating close round the artery, unarmed and without the employment of force. This accident is almost invariably fatal, there being but very few instances on record in which patients have survived it; death usually resulting from diffuse phlebitis, or the supervention of gangrene. The true cause of the fatal result in these cases was first pointed out by Hadwen, who showed that, when the vein is wounded by the aneurism-needle, it is transfixed at two points, between which the thread is drawn across; and when this is tied, a segment of the vein is necessarily included with the artery in the noose. It is this inclusion of the ligature within a portion of the vein, where it acts like a seton, and keeps up constant irritation, that occasions diffuse inflammation in the interior of the vessel; and it is consequently this circumstance, and not the mere wound of the vein, that determines the great fatality of this peculiar accident. Guided by this view of the mechanism of the injury, the indications in its treatment become obvious. They consist in removing the ligature at once, and thus, by taking away the main source of irritation, converting the wound into a simple puncture of the vessel, which readily assumes adhesive action. The Surgeon should, therefore, as soon as the accident is perceived, withdraw the ligature, and, opening the sheath about half-an-inch higher up, re-apply it to the artery there. The hæmorrhage from the punctured vein readily ceases on the application of a compress.

The occurrence of **Secondary Hæmorrhage** after the ligature of the superficial femoral is a troublesome accident, and one in which the Surgeon, to use Fergusson's expression, "will most assuredly find himself in an eventful dilemma;" and in which it is necessary that his line of action should have been well considered beforehand, as he may not have much time to spare for reflection when such an event takes place. In cases of this kind four lines of treatment present themselves, viz.: the employment of pressure; ligature of the vessel at a higher point; deligation of the bleeding artery in the wound; or amputation of the limb.

*Pressure* may be applied by placing a graduated compress of lint or compressed sponge, saturated in a solution of perchloride of iron, over the bleeding orifice, and fixing it there firmly by a horse-shoe tourniquet. This means, although extremely uncertain, occasionally succeeds; should it not do so, however, and bleeding recur a second time, it is useless to continue it, as experience has shown that the hæmorrhage will continue until the patient is worn out.

*Ligature* of the superficial femoral at a higher point, or, if the artery have been tied too high for this, the deligation of the common femoral, or of the external iliac, presents itself as a probable means of arresting the hæmorrhage. Such an operation, however, is fraught with danger, and has, I believe, invariably been followed by gangrene. It might at first be supposed that the limb would not be placed in a worse situation after the ligature of the external iliac, whether the superficial femoral had been previously tied or not; the anastomosing channels remaining the same in either case. But in reality it is not so; for, although the blood might find its way through the epigastric, the circumflex ilii, the gluteal, and sciatic arteries, into the deep femoral and its branches, yet from this point the difficulty of its transmission through the limb would be materially increased. If the superficial femoral be open, it serves as a direct and easy channel for the conveyance, to the vessels of the leg and foot, of the blood brought by the anastomoses. But when the superficial femoral is tied, this blood must find its way through a second chain of anastomosing vessels,—those intervening between the branches of the deep femoral and the articular arteries of the knee; and here the real difficulty would arise, its impulse not being sufficient to overcome the obstruction to its passage through these small channels, which might not improbably be still further obstructed by the pressure of the aneurism. Should the anastomosing circulation be sufficiently free to maintain the vitality of the limb, it is not improbable that the recurrent blood would escape from the distal side of the ligature, and thus keep up the hæmorrhage exactly as in case of wound. It appears indeed that the femoral artery, in a case of secondary hæmorrhage after the application of the ligature, is in very much the same condition as an artery which has been wounded, and in which the bleeding, having been suppressed for some days, has returned with violence: and certainly the best course for the Surgeon to pursue is the same practice that he would follow in the event of secondary hæmorrhage occurring from a wounded vessel, viz., to *cut down upon the bleeding part and apply a ligature* to it. That such an operation is surrounded with difficulties cannot be doubted; yet none would present themselves that care and skill might not overcome. The Surgeon would certainly have to cut into a part infiltrated with blood, in which the different tissues could not readily be distinguished, and the vessel when reached would be found to be soft, friable, and granulating; yet, by free dissection above and below the wound, a portion of it might at last be exposed, where its coats would hold a ligature; or should this not be found, the wound might be firmly plugged from the bottom with compressed sponge; or the bleeding aperture might be touched with the actual cautery. Should these means fail, it would be safer to *amputate the limb*, than to endeavour to arrest the hæmorrhage in any other way.

**Gangrene of the Limb** is perhaps the most frequent source of danger after ligature of the femoral artery for popliteal aneurism. It seldom occurs, however, unless the tumour be of considerable magnitude, have become diffused, or otherwise interfere seriously with the circulation through the limb. I have, however, seen it follow the operation where the popliteal aneurism had not attained a larger size than that of an orange; but, in this case, there was much œdema of the limb, and congestion of the veins, before the operation; and, on examination afterwards, it was found that the popliteal vein had been obliterated by the pressure of the tumour. The gangrene may, in some cases, be prevented by the treatment that has been pointed out at page 311, Vol. I. When it has fairly declared itself, there is necessarily no resource left but amputation, and this operation is sufficiently successful; for I find that of fourteen cases in which it was done, there were ten recoveries, and but four deaths.

The **Return of Pulsation in the Sac** after the operation for popliteal aneurism is by no means of frequent occurrence; yet it has been met with in some instances, and **Secondary Aneurism** has also been found in this situation. In these cases the patient should be put upon a careful dietetic plan, the limb be kept elevated and at rest, and pressure applied by means of a compress and bandage, or a horse-shoe tourniquet. In this way cures have been effected by Wishart, Turner, Briggs, and Liston. In conjunction with such treatment, or in the event of its not sufficing, the compression of the common femoral artery as it passes over the pubic bone would in all probability effect a cure. Should it not do so, and the tumour continue to increase, threatening to suppurate, or to occasion gangrene, amputation would be the sole resource.

The **External Iliac Artery** may require to be tied in cases of popliteal aneurism, when the superficial and common femorals are so diseased as not to admit the ligature. This occurred once to me. A gentleman who had lost the left foot and leg from spontaneous gangrene, became two years afterwards the subject of a large popliteal aneurism in the other leg. As compression failed, it was decided to tie the superficial femoral. On cutting down on the vessel the coats were found so diseased, the artery itself being cylindrically dilated and slightly aneurismal, that the operation was abandoned; and, as the common femoral felt dilated and almost uncompressible from calcification of its coats, it was decided to tie the external iliac. This I did with the able assistance of Sir W. Fergusson, at a somewhat high point, the vessel being somewhat dilated and calcified lower down. Pulsation recurred in the tumour a few hours after the operation, the collateral circulation being very free, and the patient died of secondary hæmorrhage on the fifteenth day.

DOUBLE POPLITEAL ANEURISM.—In cases of this kind the artery has been occasionally ligatured with advantage on both sides, either simultaneously, or, with more safety, consecutively. But these cases appear to me especially adapted for the employment of pressure, so as to avoid that disturbance of the balance of the circulation which is certain to ensue when one vessel is ligatured, and which may act injuriously upon the opposite aneurism. When the popliteal aneurism is conjoined with a similar disease in the groin, ligature of the external iliac is the proper course to pursue, and will effect a cure of both affections.

DIFFUSED POPLITEAL ANEURISM.—When a *circumscribed* popliteal aneurism suddenly becomes *diffused*, the patient is seized with faintness or sickness, with pain, numbness, and a hot trickling sensation in the limb, the temperature of which falls at the same time that its bulk increases, and the integument assumes a white, shining, mottled appearance, with more or less purplish discoloration. This condition usually occurs after a circumscribed aneurism has existed in the ham for some weeks or months, and on the occurrence of some sudden exertion. In some cases, however, the disease appears to have been diffused from the very first, the coats having given way, and extravasation having taken place into the areolar tissue of the limb, without the previous consolidation of the parts around the artery, or any attempt at the formation of a sac. In these cases the extravasation into the limb may either be conjoined with much œdema ; or it may be confined to the areolar tissue of the ham, and to the upper and back part of the leg, or may extend downwards under the muscles of the calf. When the patient comes under the observation of the Surgeon, the tumour is found to be solid, elastic, and irregular, without pulsation or bruit ; the limb œdematous, cold, and congested. The diagnosis of this form of aneurism is often extremely difficult, and there is great danger of confounding it with simple extravasation into the calf, with abscess, or, possibly, with malignant tumour of the leg.

*Treatment.*—The danger attending on popliteal aneurism is greatly increased by its becoming diffused. In these circumstances the ligature of the artery usually affords but a slender prospect of success, the collateral vessels being so compressed and choked by the pressure of the effused blood as not to admit of the circulation being carried on through them ; hence, in many of these cases, the only resource left to the Surgeon is to amputate the limb.

**Amputation for Diffused Popliteal Aneurism.**—The question of *Amputation* in cases of diffused popliteal aneurism is not very easily submitted to any very positive or definite rules, except where the impending gangrene is so evident as not to admit of doubt. There are, however, certain general considerations that may guide the Surgeon in deciding on this important point.

1. In some cases, the sac has either given way to a very limited extent ; or else its walls, having become thin and expanded, are yielding rapidly under the pressure of the blood, becoming confused with the surrounding parts. Here we should ligature the artery without delay : for although it is but seldom that a limb can be saved when once the blood has become infiltrated into the general areolar tissue, yet it is possible that such a fortunate occurrence may happen.

2. In other instances the aneurism has not from the first been very distinctly circumscribed. It has followed the infliction of some mechanical injury, and in the course of a week or two has acquired a considerable size, without definite or distinct limitation, being solid or but little compressible. Such a case as this can scarcely be considered, strictly speaking, a diffused aneurism ; but yet, if by *circumscribed* we mean that the blood is contained in a defined cyst with walls, it scarcely complies with such a definition, the fluid blood being rather prevented from escaping widely by a temporary barrier of coagula entangled in the loose areolar tissue of the part, and the vessel being

extensively ruptured or completely torn across. Here we are certainly justified in having recourse to compression or ligature, with a good prospect of success.

3. When the ham is occupied by a large rapidly increasing tumour, extending perhaps some way down the calf and up the thigh, and encroaching on the knee, the skin covering it being more or less discoloured, there being no pulsation perceptible in the tibial arteries, and the veins of the limb being full and even somewhat congested, the foot œdematous and several degrees in temperature below that of the opposite limb, the difficulty of coming to a decision is considerable.

In such a case as this, I think that the existence or absence of distensile pulsation is a circumstance of very great importance, and may serve to guide the Surgeon.

If there be distinct impulse of a distending character, which can be arrested by compression of the femoral artery, with some diminution of the size of the tumour, it is evident that blood is being transmitted through the sac, and that this contains some fluid blood. In these circumstances it will, when the artery is tied, subside to a considerable extent, thus allowing more space for the conveyance of the collateral circulation; and it would be but right to give the patient the chance of preserving his limb by ligaturing the vessel.

If, however, the tumour have, from the very first time when it attracted the patient's notice, been more or less solid and incompressible; and, though it may at an early period have pulsated, if this pulsation have suddenly ceased, the aneurism at the same time having undergone rapid and great increase of bulk with much tension and lividity of the integuments, œdema and coldness of the limb, with a tendency perhaps to vesication and ulceration of the skin covering the tumour, there is no resource left but amputation.

It must, however, be borne in mind, that the aneurism may become diffused, and extensively so, without any very great change in the shape and size of the limb. It is only when the sac ruptures in such a position that the blood is effused into the general areolar tissue of the limb or under the skin, that much tension of the integuments and increase in the bulk of the part take place.

4. When a rupture occurs in a part of the sac that is more deeply seated, the blood is extravasated underneath the deep fascia of the leg, and is bound down by this and by the superincumbent muscles; and disorganisation of the interior of the limb may be the result, without much, if any, change in its bulk or in the colour of the integuments, but with excessive deeply seated pain. There must always be considerable risk, in such a case as this, of confounding the arterial disease with a solid tumour; and the diagnosis can be effected only by a reference to the early history of the case, and more particularly to the existence or absence of pulsation at this period. Indeed, the existence or absence of pulsation in these cases is of the utmost importance in reference to the question of treatment. The pulsation may have ceased in a case of diffused popliteal aneurism, in consequence of the blood that has been extravasated being so confined and bound down by the fascia and muscles under which it is

effused, that it compresses or seals the mouth of the artery leading into the sac, to such an extent as to arrest the passage of blood through it, either wholly or so that it enters in a feeble stream of insufficient force to communicate an impulse to the fluid that has been extravasated into the limb. This pressure may, as in the case of which an illustration has been given (Fig. 356), be confined to the deep parts of the limb, and not give rise to much, if any, general tension of it, the blood being confined below the deep fascia, where it communicates the sensation of a hard, solid, elastic tumour devoid of pulsation. Attention should consequently not be too exclusively directed to the state of general tension of the surface of a limb, as this is by no means necessarily an indication of the state of the parts beneath : but the Surgeon should rather look to the presence or absence of pulsation. If pulsation still exist, the blood continues to find its way into the sac, and most probably through it, the tension of the parts not having yet reached its maximum. If there be no pulsation, he may be sure that the entrance of blood into the diffused aneurism has ceased in consequence of compression exercised on the mouth of the artery leading to it, by the tense condition of the surrounding and enveloping tissues re-acting on the mass of blood effused beneath them. In such a state of things as this, the vitality of the lower part of the limb can only be maintained by the blood that may find its way through the anastomosing channels ; and this may be sufficient for the purpose if the tension of the limb be not general, the extravasation being confined below the deep fascia. If surgical interference be delayed in such a case as this, the deep fascia will soon give way by over-distension and rupture, and the blood will be infiltrated into the general areolar tissue of the limb ; and then, by compressing those collateral branches that have hitherto maintained a feeble circulation in it, will infallibly occasion gangrene. If, on the other hand, recourse be had to ligature of the main artery, the anastomosing circulation, which may have been barely sufficient to keep up a feeble vitality in the leg and foot, will be so much interfered with that gangrene of the limb inevitably ensues. The only resource, therefore, that is left in these cases is to amputate at once, in order that the patient may be saved the shock of the constitutional disturbance occasioned by the setting in of mortification, as well as the pain and risk of a previous unnecessary operation.

5. When gangrene threatens, the leg and foot having become cold, the skin being either pale, tallowy, and mottled, or discoloured, of a purplish hue, with perhaps vesications and much œdema, whether the ligature have been previously applied to the femoral artery or not, or whatever the condition of the aneurism may be, whether circumscribed or diffused, the patient will stand a better chance of ultimate recovery by having the limb removed at once above the knee. The part at which amputation should be performed in these cases is a point deserving consideration. If the femoral artery have been ligatured, the thigh should be amputated on a level with the ligature, the artery being cut just above this. In this way the double risk which the patient would otherwise run of secondary hæmorrhage from the seat of the ligature, as well as from the face of the stump, will be reduced to a single chance of hæmorrhage from the stump. If the amputation be the primary operation, it should be done at the lower third of the thigh, provided the extravasation be confined to below the knee ; or higher up, if the effused blood have extended above this joint.

### ANEURISM OF THE TIBIAL ARTERIES.

*Aneurisms of the Tibial Arteries* are extremely rare, except as the result of wound, yet they are occasionally met with; and in the museum of St. George's Hospital is a preparation of a small aneurism of the posterior tibial. I have only seen one case during life, that of a man suffering from cardiac and renal disease, admitted into University College Hospital under my care for an aneurism of the anterior tibial at the lower part of the upper third of the right leg. The signs were well marked—pulsation forcible and excentric, bruit loud. Compression was used without avail; and as he was anasarcous, no other surgical treatment could be adopted. He left the hospital uncured.

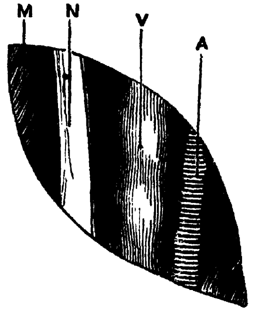


Fig. 400.—Diagram of Left Popliteal Artery.
A. Popliteal Artery.
V. Vein.
N. Internal PoplitealNerve.
M. Biceps Muscle.

The tibial arteries sometimes require ligature either for injury or for disease.

**Ligature of the Tibial Arteries.**—The **Posterior Tibial Artery** may be tied in two parts of its course; either behind the ankle or in the calf of the leg. The line of direction of the posterior tibial artery is from a point about one inch below the knee, and equidistant from the two sides of the limb, to a point one finger's breadth behind the internal malleolus. Behind the ankle it may be reached by making a semilunar incision three inches long, about three-quarters of an inch behind the inner malleolus, towards which its concavity should look. After dividing the integument and superficial fascia, the deep fascia, which is usually single, but may be double, must be laid open; this closely invests the vessel, nerve, and tendons in this situation; under it the artery will be found accompanied by two veins, from which it must be separated before the ligature is passed. Anterior to the vessel, and nearer the bone, are the tendons of the flexor digitorum communis and tibialis posticus muscles; behind, are the nerve and the tendon of the flexor proprius pollicis.

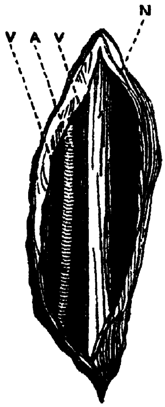


Fig. 401.—Diagram of Right Posterior Tibial Artery, behind Inner Malleolus.
A. Posterior Tibial Artery.
V. V. Venæ comites.
N. Posterior Tibial Nerve.

In the middle of the leg, the posterior tibial artery should be tied only for a wound in that situation. In such circumstances no regular operation can be performed, but an incision of sufficient length, taking the wound for its centre, should be made through the gastrocnemius and soleus parallel to their fibres, when, after these have been cut through, the deep fascia will be exposed. This must next be opened, when the artery will be found accompanied by its veins, and having the nerve to the outer side. From the depth at which the vessel is situated, and the free incisions that it is necessary to make through muscular parts, it is extremely difficult to apply the ligature in this situation. The latter steps of the operation may be much facilitated by flexing the leg on the thigh, and extending the foot, so as to relax the muscles.

The **Anterior Tibial Artery** may be tied in several situations; but, like the posterior tibial, it should not be ligatured in the upper or middle parts of the leg, except for injury. The difficulties of the operation are lessened as the ankle is approached, where the artery becomes superficial, and may easily be secured. The line of direction of the anterior tibial artery is from the inner side of the head of the fibula to a point exactly midway between the two malleoli; and the course of the dorsal artery of the foot is from this point to the cleft between the first two toes.

In the upper third of the leg the artery lies deeply between the tibialis anticus and extensor communis digitorum muscles, surrounded by veins, and having its nerve to the outside. If it be ever found necessary to tie it in this situation, the incision requisite to expose it should be made at least four or five inches in length; and especial care should be taken not to cut into the muscular substance, but to open the first intermuscular space to the outside of the tibia, at the bottom of which the vessel will be found. In the middle third of the leg, the artery will be found between the tibialis anticus and the extensor proprius pollicis; it is best reached here by keeping well to the outside of the tibialis anticus.

The **Arteria Dorsalis Pedis** may be felt pulsating, and may readily be secured, as it runs forward from the ankle-joint to reach the space between the first and second metatarsal bones, lying between the tendon of the extensor pollicis and that of the extensor brevis digitorum, by the inner tendon of which it is crossed at its lower part.

# DISEASES OF THE ORGANS OF SUPPORT AND MOTION.

## CHAPTER XLVI.

## DISEASES OF BONE.

### PERIOSTITIS.

**Inflammation of the Periosteum** is of common occurrence as a result of injuries, as a morbid process dependent on disease of the subjacent bone, or as a consequence of syphilis and rheumatism. It often affects the membrane covering the shaft of a bone, and very commonly the articular end, becoming associated with inflammation of the contiguous joint. When it is acute, the membrane becomes thickened, soft, and vascular, and loosens from the subjacent bone. When chronically inflamed, the periosteum becomes thickened by the deposit of plastic matter within and beneath it, and the subjacent bone usually participates in the changes, undergoing hypertrophy and induration, constituting a *node* (Vol. I., p. 867).

SYMPTOMS.—The symptoms of periostitis consist of a hard, elongated, but somewhat puffy swelling without cutaneous discoloration—a node—not distinctly circumscribed, and attended by much pain in the part, especially at night, with tenderness on pressure.

TREATMENT.—In the treatment of the acute form of the affection, the free application of leeches, with hot fomentations, and the administration of calomel and opium, will arrest the disease, and give relief to the patient. In the more chronic form, the continued administration of the iodide of potassium will take down the swelling, remove the nocturnal pains, and materially improve the local condition of the part. In those cases of periostitis which are of syphilitic character, iodide of potassium may almost be looked upon as a specific. Added to this, the occasional application of leeches and repeated blistering will be of essential service. If there be much thickening, the parts suffer from the tension of the structures; here considerable relief will be afforded by the free division of the periosteum down to the bone, either through the skin, or subcutaneously by means of a tenotome slid under it.

**Subperiosteal Abscess** is an acute disease attended by great swelling and redness of the limb, deep tensive pain of the most severe character, and great constitutional febrile disturbance. The limb becomes œdematous after a few days, but without relief to the symptoms; the swelling localises itself, and at last deep fluctuation may be detected.

The bone that is most commonly affected is the tibia, at its anterior part, doubtless owing to its exposed situation subjecting it more readily than other bones to the common causes of this inflammation, viz., blows and cold.

Subperiosteal abscess of the tibia usually occurs in children and in very young adults.

The pus is thick, and has been found to contain bacteria as soon as the abscess is opened, in this respect differing from the pus of ordinary acute abscess in the soft structures. At the bottom of the abscess the bone will be felt bare and rough. There is a superficial patch of osseous structure in a state of acute necrosis. The death of the bone is due to the violence of the inflammation. A scale is killed by the intensity of the local inflammation, just as a shred of areolar tissue may die from the same cause. The scale will separate at a later period. In some cases, however, a great portion of the shaft will be found to be involved, and the case is one rather of acute general necrosis than of ordinary subperiosteal abscess.

The *Treatment* of subperiosteal abscess is simple and rational. A free and deep incision through the inflamed, tense, and thickened periosteum lets out the pus and gives immediate relief. After this has been done, the Surgeon must wait for the separation of the necrosed bone before the wound will heal, and the treatment then resolves itself into that of necrosis.

### OSTEITIS.

**Osteitis** varies in its characters, causes, and results, according as it affects the long or the short bones, the compact or the cancellous structures. When affecting the shaft of a long bone, it usually occurs as the result of blows or of exposure to cold and wet. When it occurs in the articular ends, or in the short cancellous bones, although often immediately excited by these causes, it is more commonly associated with a strumous habit of body. In these cases, also, it frequently follows that deterioration of health which is consequent on scarlatina or measles.

*Acute Osteitis* commonly leads to necrosis of the affected bones, and is more frequent in the shafts than in the articular ends of long bones. When occurring in the cancellous bones, it leads to acute caries. Its symptoms and pathology will, therefore, more conveniently be considered when we speak of these diseases than at present.

*Chronic Osteitis* is that which occurs most commonly from slight traumatic or climatic causes in delicate or strumous children. It is a fertile source of incurable disease of the spine-joints and bones, and will frequently be referred to in its congestive and strumous forms in treating of these affections.

PATHOLOGY.—When a portion of bone is chronically inflamed, the periosteum and medullary membrane participate in the morbid action, and, together with the affected osseous structure, become highly vascular ; at the same time the inflamed bone becomes enlarged and softened, partly in consequence of changes induced in its organic constituents, and partly in consequence of the cancellated structure becoming expanded from interstitial absorption ; the cancelli being filled with a sero-sanguineous fluid. The compact structure of inflamed bone undergoes a peculiar kind of laminated expansion, so that a section of it presents an appearance of concentric parallel layers. When the inflammation is chronic, its character will vary according as it is strumous or not. When it is strumous, the bone is expanded, softened, and reddened. This form is often seen on ends of long bones, especially the tibia. When traumatic, on the other hand, and when occurring in a healthy subject, the bone becomes very dense, indurated, and compact; looking and cutting more like ivory than ordinary bone. In these cases the medullary canal becomes closed by deposit of new and hard bone; and if the bone have been cut short, as on the end of a stump, it will become smooth and rounded. Sometimes considerable elongation without much or any thickening will take place. I have seen, as the result of chronic osteitis, the tibia from one and a half to two inches longer than its fellow.

Symptoms.—The symptoms of chronic osteitis consist of enlargement of the affected bone, with deeply seated pain and great tenderness in the limb: the pain, as in periostitis, is greatly increased at night, and, when the disease is chronic, is much influenced by the state of the weather.

Treatment.—In the treatment of the *acute* cases, our principal reliance must be on local leeching, with hot fomentations, poultices, and opium. In the more *chronic* form of the affection, when the bone has become thickened and enlarged, nothing of a curative kind can be adopted; and the only remedy consists in the administration of iodide of potassium for the relief of the pain, with perhaps the occasional application of leeches. Should these means fail in giving relief, and the pain continue of an excessively distressing and persistent character, I have for many years past practised the following operation of *linear osteotomy*. An incision about three inches long is made directly down on the chronically inflamed and indurated bone, being carried through the periosteum, so that the scalpel grates upon the bone. By means of a Hey's saw this cut is extended into the substance of the bone as far as the medullary canal, or deeply into its cancellous tissue. Some bleeding occurs, but it can always be arrested by position and pressure. The wound is then closed.

When osteitis tends to harden and consolidate the bone, there is no danger connected with this condition; but it often becomes distressing from the severity of the tension and nocturnal pain accompanying it.

When osteitis is of the strumous character, there is great danger of its terminating either in caries or in chronic suppuration of the affected portion of bone.

In either case an early, deep, and free incision, by linear osteotomy, should be made into the inflamed bone. Nothing relieves the tensive pain so effectually as this, and nothing stops so decidedly the tendency to secondary mischief, whether in the form of caries or of abscess. In this way tension is taken off; and the pain, which appears to be dependent on the compression of inflamed bone by its own condensed structure, is at once relieved. "Linear osteotomy" is an operation especially applicable to osseous nodes of the long bones, or to chronic osteitis of the articular ends of the tibia, and is a far less severe mode of treatment than trephining the bone, which has occasionally been adopted in such cases; while it is equally efficacious. After a time, when all morbid action ceases, the hypertrophied bone does not give rise to any very serious inconvenience, except such perhaps as may be occasioned by its bulk.

Osteitis is principally of importance to the Surgeon from its connection with other more serious diseases of bones, in which it not unfrequently terminates. These conditions are Suppuration of Bone, its Ulceration, Caries, and Necrosis. The best and surest mode of preventing these serious sequences is the early performance of osteotomy, as just described.

## SUPPURATION OF BONE.

**Suppuration of Bone** may present itself in two forms, the *Diffused* and the *Circumscribed*.

**Diffuse Suppuration: Osteo-myelitis.** In this disease the medullary membrane is primarily affected, the inflammation rapidly extending through the whole of the medullary canal and adjoining cancellous structure, which speedily become filled with pus. Stanley observes that the medullary membrane becomes vascular like the conjunctiva in chemosis, and is often black and gangrenous.

Osteo-myelitis commonly occurs as a consequence of injuries by which the medullary canal is opened, such as compound fractures, more particularly of the femur. It may also be developed as the result of the injury sustained by a bone in an amputation or excision. The presence of the disease may be suspected when, after an injury to or an operation involving a bone, the limb swells, and becomes tender, abscess forms, and profuse suppuration is established, more abundant and more persistent than can be accounted for by the amount of inflammation in the soft parts around the bone. The suppuration may amount to many ounces of pus in the day, and the discharge is often dark and fetid. The soft parts retract from the bone, and this where exposed is dry, yellow, and dead, being denuded of periosteum.

This disease is undoubtedly most dangerous, usually proving fatal. In it death may ensue in two ways—either by the exhaustion consequent on the prolonged and profuse suppuration, or by pyæmia dependent on thrombosis of the veins of the bone and consecutive blood-poisoning. There is a triple pathological sequence of osteo-myelitis, osteo-phlebitis, and pyæmia, which is of a marked character.

PATHOLOGY.—Osteo-myelitis is a diffuse inflammation of the medullary membranes of the long bones, the interior of which has been opened up to the air by accidental or surgical wound. It is of an erysipeloid or diffuse character, and in the majority of cases affects a septic type of disease. It is, in fact, one of the septic diseases that add to the fatality of the larger amputations and severe injuries of bones.

Sir Joseph Fayrer, who has had abundant opportunities of studying this disease in India, and who has done much to point out its connection with pyæmia, makes the following important practical remarks as to its causes. "It (osteo-myelitis) is no doubt to be classed among the large group of evil results which are to a great extent caused by what has been recently called 'Hospitalism,' and it sometimes appears almost in an epidemic form, but it may and does occur periodically under the most favourable circumstances."

After death, the appearances presented by the inflamed bone will, if it have been the seat of compound fracture, be confined to the upper fragment; if it have been the seat of amputation or excision, they will extend through the whole of the bone that is left. They are as follows. The periosteum and outer surface of the bone will appear to be slightly injected. On making a longitudinal section of the bone, the part that is inflamed will be found to present the following appearances. The medullary canal is filled with pus or a reddish puriform fluid; the medullary membrane is swollen, soft, pulpy, of a deep red or reddish-brown colour; the compact bone has a pinkish tinge, and the cancellous osseous structure is often of a bright rosy hue. In a case of compound fracture, the contrast between the deep coloration of the inflamed portion of bone and the naturally pallid appearance presented by that which is not diseased, and more particularly the deep red hue of the medullary membrane in the one, and the pale yellowish waxy-looking fat filling the medullary canal in the other, is most striking and remarkable. Fayrer describes the medullary canal, in advanced stages of the disease, as being filled with a mass of dead blackened medulla, *débris* of bone, and pus.

The *Treatment* consists in supporting the patient's constitutional powers by a tonic and stimulating regimen, and by scrupulous attention to hygienic rules.

So far as the affected bone is concerned, nothing can be done to it except its removal; but whether this should be done in the continuity of the bone or at a higher joint, is a question on which different opinions are entertained among surgical authorities. If an operation be performed upon the continuity of a bone affected with diffuse suppuration in the medullary canal, the injury inflicted by the saw is very liable to set up great inflammatory action, and to develop the disease in the part of the bone which is left. Hence, if secondary amputation of an injured limb should be rendered necessary, the bone being affected with osteo-myelitis, it is strongly urged by some Surgeons, especially J. Roux, that the operation should be performed at some joint above the injured and diseased bone, in preference to amputation through its continuity. Roux, who had extensive experience in the Italian war, successfully disarticulated the thigh at the hip-joint, in four cases of osteo-myelitis consequent on gunshot injuries of the lower end of the femur. Of 22 cases in which he performed secondary disarticulation of other joints for osteo-myelitis, all recovered; whereas every soldier died, whose limb was secondarily amputated through the continuity of the injured bone after the battles of Magenta, Montebello, Marignano, and Solferino. On the other hand, Larrey does not consider disarticulation absolutely indispensable, even in cases of acute osteo-myelitis; and Longmore has met with cases in which recovery has followed the simple removal of portions of dead bone —the disease in these instances having assumed a chronic form. Fayrer advises that, where osteo-myelitis is suspected to be present in a stump after amputation, the medulla should be examined by a probe. If this soon impinge on healthy bleeding medulla, the Surgeon may wait for the efforts of nature to throw off the diseased bone; if, on the other hand, the probe encounter only dead bone and pus, then the sooner amputation is performed, the better.

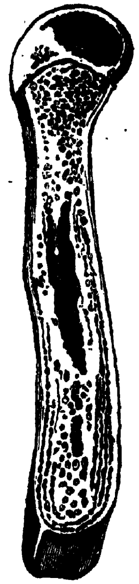


Fig. 402.—Diffuse Suppuration of Humerus, after Excision of the Elbow-Joint.

The special danger in osteo-myelitis consists in the tendency to the supervention of osteo-phlebitis and pyæmia; and, in determining upon the amputation or excision of a bone thus affected, it is of the first importance not to delay the operation until pyæmic symptoms have set in. There is a period between the development of the local osseous inflammation and the constitutional pyæmia, which it is most important not to allow to slip by. During this period the patient is affected by surgical fever, but there are no rigors. If once the characteristic rigors and the high temperature and profuse sweats of pyæmia have set in, I believe that operation can be of no use, as the patient will certainly perish of secondary deposits or of pyæmic blood-poisoning. But, before rigors have occurred, the amputation may be done with a good prospect of success.

**Chronic Abscess of Bone.**—The more chronic form of suppuration of bone usually assumes a circumscribed character, and leads to the formation of abscess. The abscesses are usually met with in the cancellated structure, and occur with special frequency in the head and lower end of the tibia. In some instances they are tolerably rapid in their formation, but in the majority of cases are excessively chronic. When of a more acute character, they are probably the result of the softening of tubercle previously deposited in the bone; and, forming in the cancellous structure, are very apt to undermine the contiguous cartilage of incrustation, and eventually to burst into the neighbouring joint (Fig. 403). When of a more chronic character, they are usually of very small size, and are deeply seated in the substance of the head, or in the medullary canal of the bone; the osseous substance covering them, having long been the seat of chronic inflammation, becomes greatly thickened and indurated. Most commonly the quantity of pus contained in these abscesses is extremely small, and it is often mixed with cheesy or tuberculous matter, or contains portions of necrosed bone intermingled with it. In some cases, however, Stanley has observed that abscesses of bone are large, containing a considerable quantity of fluid.

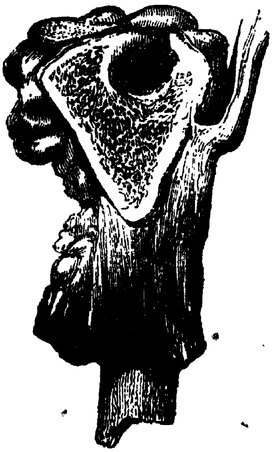


Fig. 403. –Abscess in the Head of the Tibia.

The *Symptoms* of chronic abscess of bone are usually of the following character. The patient, after the receipt of an injury, perhaps, has noticed that at one spot the affected bone has become swollen and painful; the skin covering it preserves its natural colour in the majority of cases, but in some instances becomes red, glazed, and œdematous; the pain, which is of a lancinating and aching character, is usually remittent, often ceasing for days, weeks, or months, and then returning, under the influence of very trivial causes, with its original severity. It is especially troublesome at night, and is always associated with a degree of tenderness of the part; and indeed, in the intervals of its accession, it will be found on careful examination that there is always one tender spot in the enlarged and indurated bone. The long persistence, for years perhaps, of these signs will usually point to the existence of a small circumscribed abscess under the thickened wall of the bone. But it must be borne in mind that the same local symptoms may be induced by three other conditions: 1, by the inclusion of a small portion of dead bone within a dense and impervious casing; 2, by the pressure of the osseous structures, greatly thickened and condensed by chronic inflammation; and, 3, by the expansion of the bone by a cystic growth. For all practical purposes the diagnosis is of little consequence, as the treatment is the same, whether the pain and other symptoms arise from the confinement of a few drops of pus, from the inclusion of necrosed bone, from the pressure of hypertrophied osseous tissue, or from cystic disease.

The danger of chronic abscess of the end of a long bone will greatly depend on its proximity to the articular surface of the bone. If near this, it will probably lead to thinning and eventual disintegration of the cartilage, which at last becomes perforated, so that the pus and osseous *débris* enter the joint, which is at once and acutely destroyed.

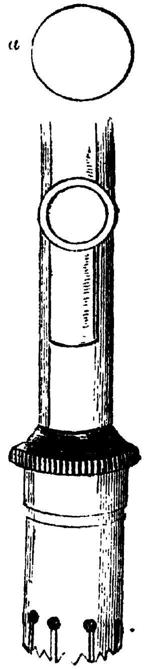


Fig. 404.—Bone Trephine.

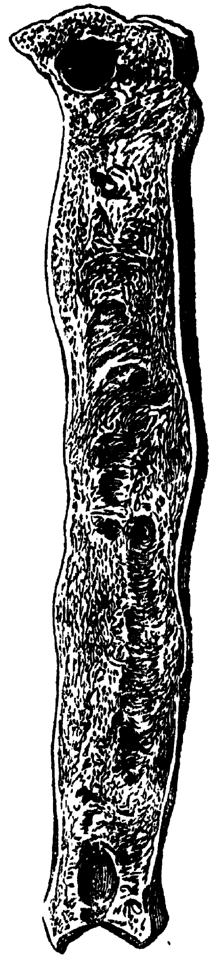


Fig. 405.—Section of Tibia, showing Chronic Osteitis and Circumscribed Abscesses of many years' duration.

If the chronic osseous abscess be situated near the junction of the epiphysis with the shaft, this event is not so likely to occur. The surrounding bone simply becomes thickened; and though the health may suffer from the constant wearing pain, the joint is not in peril, and relief may readily be given by operation.

*Treatment.*—As a circumscribed abscess in bone cannot perforate the dense osseous structure overlying it by any process analogous to the pointing and discharge of an abscess in the soft parts, it becomes necessary for the Surgeon to open up a vent for the pus. This may be done either by linear osteotomy or by the trephine. In some cases simple linear osteotomy, as described at p. 167, may be practised; but should the bone be much thickened and the osseous structures greatly indurated, the trephine is the best instrument to use for opening the abscess. The proper way of doing this has been pointed out by Quesnay and Brodie. It consists in trephining the bone, so as to make an aperture for the exit of the pus, with an instrument having a small crown, of the size represented at *a*, Fig. 404. So soon as a vent has been given to the pus, which is often cheesy and occasionally very offensive in its character, the patient will experience great and permanent relief. In performing this operation, there are several points that deserve special attention. The bone must be exposed by a T- or V-shaped incision, made over the spot which has been found to be uniformly tender on pressure: and to this the trephine should be applied. The trephine should have a small and deep crown of the size and shape represented in Fig. 404; and it is well always to be provided with two instruments of the same shape and size that will exactly fit the same hole, lest one become disabled by the density and hardness of the osseous case, as I have seen happen. When the trephine has penetrated to a sufficient depth, the button of bone may be removed by means of an elevator; but care should be taken not to perforate the whole thickness of the bone. The diseased cavity will very commonly at once be opened in this way, a small quantity of pus escaping, which may, however, readily be overlooked, as it is carried away in streaks with the blood, which flows freely from the cut bone. Should no pus escape, perhaps a portion of dead bone, or some dark gritty masses of disorganised osseous tissue, are exposed; if so, they must be removed with a gouge. But if neither of these conditions be found, the Surgeon must not be disappointed, but pierce the neighbouring osseous tissue in different directions by means of a perforator, when perhaps the abscess will be opened; should it not be so, the patient will still in all probability be materially benefited by the removal of the circle of bone, and the consequent relief to the compression of the osseous tissue. After the operation, the cavity left must be dressed from the bottom with wet lint, and a poultice be afterwards applied; it will gradually fill up with fibrous tissue, leaving the limb unimpaired in utility and strength.

In very chronic cases of circumscribed abscess of bone, chronic osteitis of a considerable portion or the whole of the shaft may slowly take place, the bone becoming greatly enlarged, thickened, and generally diseased from end to end. Fig. 405 is a representation of a section of the tibia in such a state of combined suppuration and inflammatory hypertrophy, removed by amputation from a woman who had suffered for 23 years from the disease. In such cases, amputation or excision is the sole means of relief.

## CARIES.

By **Caries** some Surgeons mean a kind of ulceration of bone; others, a species of disintegration of the osseous tissue; and Stanley includes under this term the various changes consequent on chronic suppuration of the cancellous structure. But caries, I think, properly means a disease of the bone, characterised by increased vascularity, softening, and ultimate disintegration of the osseous tissue. It appears to consist in a breaking down of the organised portion of the bone, in consequence of which the earthy matters become eliminated in a granular, molecular, and almost diffluent form in the pus formed by the inflammation of the surrounding more healthy structures.

STRUCTURE.—On examining a portion of carious bone, it will be found to be porous and fragile, of a grey, brown, or blackish colour; partly broken down in softened masses, and partly hollowed out into cells, which contain a reddish-brown and oily fluid. The process of wasting which goes on in the bone, appears to be partly the result of ulceration, and partly of disintegration of its tissue. In many cases, small masses of dead bone lie loose and detached in the carious cavity. Around this carious portion, the bone, as well as the medullary and periosteal membranes, are usually extremely vascular; and, in many cases, hardened compact masses of osseous tissue will be found deposited around the carious cavity, or even forming its exterior wall. These changes are most commonly met with in the cancellous structure, but the compact tissue may likewise be affected. As caries frequently occurs in the cancellated tissue, it is commonly met with in the heads of bones; and here the disease is extremely dangerous, being apt to undermine and destroy the contiguous articular cartilage, and thus implicate the joint. This caries of the articular ends of bones is consequently a most serious affection, and is a very frequent cause of incurable joint-disease, such as suppuration and destruction of cartilage, followed perhaps by partial ankylosis.

RELATIVE FREQUENCY.—Billroth and Menzel of Vienna have examined the question of the relative frequency of caries in different bones. In 1996 cases, the numbers were: skull, 161; facial bones, 44; vertebral column, 702; sternum, clavicle, and ribs, 184; bones of shoulder-joint, 28; elbow-joint, 93; wrist and hand, 41; pelvis, 80; hip-joint, 189; knee-joint, 238; ankle-joint and foot, 150; scapula, 4; humerus (shaft) 13; radius, 2; ulna, 4; femur (shaft), 31; tibia, 30; fibula, 2. A classification in regions gives: head and spine, 1091; upper limbs, 185; lower limbs, 720. Hence it appears that, while any bone may be affected with caries, it is most frequently met with in the short and cancellous bones.

CAUSES.—Caries usually occurs in constitutions that have been debilitated by struma or syphilis, often without any other apparent cause. Caries occurring in *strumous constitutions,* and affecting the short bones, as those of the tarsus or spine, or the heads of the long bones, as the tibia, usually, if not always, commences in the central cancellated structure of the bone, which becomes congested, softened and disintegrated; in many cases without any external cause, but apparently simply from the diminution of vitality in those parts of the osseous structure which are farthest from the periosteum, and which do not, like the deeper structures of a long bone, receive a supply of blood from an internal or medullary membrane. In these cases, the inflammation of the soft investing parts, and the destruction of the joint, which usually ensue, are consecutive to the disease in the bone.

In *syphilitic constitutions* caries is apt to affect the surface of the bone, disintegrating and eroding this in a remarkable manner. This condition has been described by Stanley as true *ulceration of bone,* and he regards it as distinct from caries, and analogous to ulcers of the soft parts. Here the disease does not penetrate deeply, but leaves the surface rough and porous, with a good deal of inflammation in the soft parts around the affected bone. He states that it only occurs in adults, and in males, and is very chronic; it is met with primarily in the bones of the spine, but also occurs on the articular surfaces in advanced stages of joint-disease.

SYMPTOMS.—The symptoms indicative of the occurrence of caries are very equivocal, and are not unfrequently, in the early stages, mistaken for those of ordinary phlegmonous abscess or rheumatism. They consist of pain in the bone, with a good deal of redness and swelling in the soft tissues covering it; abscess at last forms, often of considerable size; and, on letting out the pus, the character of the disease will be recognised, as the bare and rough bone may be felt with a probe, which sinks into depressions upon its surface, which, though rough, yields readily to the pressure of the instrument. The cavity of the abscess gradually contracts, leaving fistulous openings, which discharge a fetid pus, usually dark and sanious, intermixed with granules of bone, and containing a superabundance of the lime phosphates. The fistulous openings are generally surrounded or concealed by high spongy granulations, and the neighbouring skin is duskily inflamed.

These sinuses or fistulæ are often long and tortuous. They wind along and around the muscles, the pus finding its way along the lines of least resistance in the muscular planes of areolar tissue, and the external opening being often situated at a considerable distance, perhaps many inches, from the diseased bone. In these cases, a long and flexible probe is required to traverse the sinuosities of the fistulous track so as to reach the bone at its extremity; and here Sayre's vertebrated probe (Fig. 406) is most invaluable, being flexible and accommodating itself to the windings of the canal. A similar instrument has been also devised by Steele of Bristol.

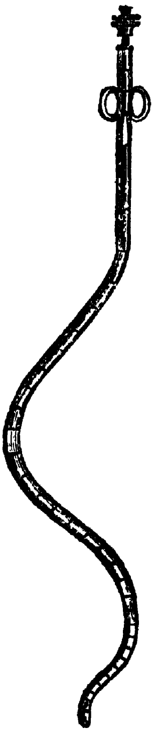


Fig. 406. Sayre's Vertebrated Probe.

Caries is very liable to be accompanied with disease of internal viscera. Billroth, in the cases investigated by him to which reference has already been made, found that there were cheesy or tuberculous deposits in internal organs in 54 per cent. He gives the proportions in which these were met with in disease of different bones as follows: shoulder-joint, 77·7 per cent.; bones of the chest, 65·5; ankle, 64; knee, 62·6; elbow, 62·3; spine, 56·8; wrist, 51·2; pelvis, 50·5; hip, 47·5; tibia, 58; skull and face, 33·6. The lungs were most commonly affected. It may be supposed, that in many instances the internal disease arises from absorption of morbid material from the diseased bone and its subsequent deposition; and this view is favoured by the fact that the larger proportions of cases where such disease was found were met with in the shoulder and bones of the chest. On the other hand, as Billroth points out, it is not easy to explain in this way why disease of more distant joints, as of the ankle and knee, should be more frequently accompanied with internal deposits than disease of the hip. Hence the morbid deposits in internal organs, accompanying caries, are in many cases at least more satisfactorily explained as being the results of the constitutional vice of which the caries is one manifestation.

Certain special diseases of internal organs are also mentioned by Billroth as having been noticed in the cases which he analysed. Among these were subacute or chronic hydrocephalus: and albumenoid degeneration of the liver, spleen, and kidneys.

Treatment.—The treatment of caries must be conducted in reference to the constitutional cause that occasions it, the removal of which is the first and most essential element in effecting a cure. If it arise from syphilis, this must be eradicated; if from struma, the general health must be improved. By the removal of such causes, the disease will often cease spontaneously, and even undergo cure, more especially in young subjects. Hence, it is well not to be in too great a hurry to interfere, by operative means, in the caries of the small bones of children. I have often seen cases, especially of caries of the bones of the hands and feet, in which an operation for the removal of the diseased bone was apparently indispensable, recover spontaneously on change of air, and attention to the general health of the child; the disintegrated particles of the diseased bone being eliminated piecemeal.

In the first stage of caries, which is inflammatory, measures should be taken, by means of appropriate local and constitutional antiphlogistics, to subdue the activity and limit the extension of the disease; and when this has fallen into a chronic stage, constitutional alteratives should be employed. Amongst these, cod-liver oil, the iodides, and change of air, more especially to the sea-side when the patient is young, should hold the first place. Counter-irritation is of little avail in these cases in arresting the progress of morbid action. By means of blisters, iodine, and issues, thickening of the periosteum and of the soft structures covering the diseased patch of bone may be lessened, and pain subdued; but the real progress of osseous disease cannot, I think, be influenced by such means, when once it has passed the earliest stage of inflammatory congestion.

When the disease has fallen into a chronic condition, and nature seems unable to eliminate the carious bone, all reparative action having ceased, or being inefficient for the restoration of the integrity of the part, an operation becomes necessary. When the operative procedure has reference to the diseased part itself, it is impossible to be too careful in delaying it until the acute stage of the disease has passed, and the inflammation in the bone and surrounding tissues has subsided into a chronic state. Unless this be done, the excited action set up by the operation will infallibly give fresh impetus to the disease, which will make more rapid progress, and may perhaps terminate in diffuse suppuration of the bone.

**Operations.**—The operations practised upon carious bones are of four kinds; consisting either in simple Removal of the Diseased Portion of Bone; in Excision of the Carious Articular End; in Resection of the whole of the Bone affected; or in Amputation of the whole Limb.

Before proceeding to the *Removal of the Carious Portion of the Bone* the limb should be rendered bloodless by Esmarch's method, as the operator will then be able to see exactly what he is doing, instead of working in a deep hole filled with blood. The bone is best removed by means of the gouge. This instrument is especially useful in those cases in which short, thick bones, or the articular ends of the long bones, are affected, without the neighbouring joints being implicated. In applying the gouge, the diseased portion of bone should be exposed by a crucial incision, and, if necessary, its cavity opened by a small trephine. The gouge, fixed in a short round handle, is then freely applied, and the diseased tissues are scooped and cut out. In order to do this efficiently, it is desirable to be furnished with instruments of different shapes and sizes, so that there may be no difficulty in hollowing or cutting away every portion of bone that is implicated. I have found the *gouge-forceps* (Fig. 414), a very useful addition to the gouge in clearing away angular fragments and projections of bone, and thus removing the whole of the diseased structures. In some cases Marshall's *osteotrite* (Fig. 407) will be found a very serviceable instrument, clearing away the softened carious bone without risk to the surrounding healthy structures.

In removing the carious bone with these instruments, the Surgeon may be sometimes at a loss to know when he has cut away enough. In this he may generally be guided by the difference of texture between the diseased and healthy bone; the former cutting soft and gritty, readily yielding before the instrument, whilst the latter is hard and resistent; so that, when all the disease is removed, the walls of the cavity left will be felt to be compact and smooth. In some cases, the healthy bone may have been softened by inflammation; should there be any doubt as to the condition of what has been gouged out, it may be solved by putting the *detritus* into water, when, if carious, it will become either white or black: whereas, if healthy, but inflamed, it will preserve its red tint. In operating on young children especially, it is well not to have the gouge too sharp, lest the inflamed, but otherwise healthy though somewhat softened bone, be cut away together with that disintegrated by caries. The cavity that is left should be lightly dressed from the bottom, and allowed to heal by granulation, when it will gradually fill up by the deposition of fibrous material in it.

Instead of removing the affected bone by means of instruments, Pollock has recommended that it should be dissolved by the application of a strong solution of sulphuric acid. The treatment is carried out as follows: the carious surface or cavity being exposed as before described, a solution of equal parts of strong sulphuric acid and water is applied by means of a glass brush or rod, and this may be repeated daily till the whole surface is quite free from diseased bone. In deep cavities a piece of lint soaked in a weaker solution (one part of the acid to five or six of water) may be stuffed in and left for two or three days. The slough resulting may in a day or two more be peeled off with forceps and the application repeated if any diseased bone can still be seen. The treatment is said to be efficacious, and the pain accompanying it is not severe.

When caries affects the articular ends of the bones, as those that enter into the formation of the elbow or shoulder-joints, it may be so situated as not to admit of removal in the way just indicated, but to require *Excision* of the diseased articulation: this operation we shall consider in a subsequent Chapter. When caries involves a bone so extensively that neither of the preceding plans can successfully be put into operation, it becomes necessary to perform either the *Resection* of the whole of the bone, if it be of small size, or *Amputation* of the limb, if of greater magnitude or if the neighbouring joints be extensively affected. Thus, for instance, resection of the os calcis may be required for caries of that bone; while, if the whole of the tarsus be affected, amputation is the only resource.

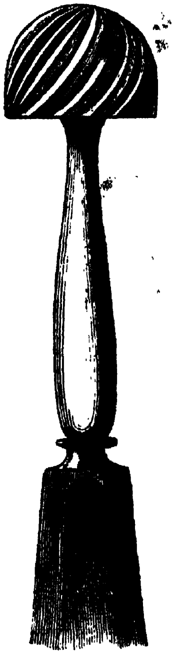


Fig. 407.—Marshall's Osteotrite.

### NECROSIS.

The transition from Caries to **Necrosis** is easy. Caries may be regarded as the granular disintegration or molecular death of the osseous tissue, conjoined with suppuration of the surrounding healthy parts—a condition closely analogous to ulceration of the soft tissues: whilst necrosis must be looked upon as the death of the osseous tissue as a whole—a condition indeed, closely resembling that of gangrene of the soft parts. Whilst caries, however, chiefly affects the cancellous structure, necrosis is met with in the compact tissue of bone, and far more frequently occurs in the shafts than in the articular ends of the long bones. It is, however, an error to suppose that the cancellous structure is exempt from necrosis; thus in the head of the tibia, or in the os calcis, small masses of necrosed bone are not unfrequently found lying in the midst of carious or suppurating cavities. Different bones are affected by necrosis with varying degrees of frequency. The tibia at its anterior part is most frequently diseased; the femur in its lower third is also very commonly affected. The lower end of the humerus is not so often necrosed; but not uncommonly the phalanges of the fingers from whitlow, the skull from syphilis, the lower jaw from the emanations evolved in the manufacture of phosphorus matches, and the clavicle and ulna from injury or constitutional causes, are found affected by necrosis.

CAUSES.—The causes of necrosis are of very various character. We have just seen that it is *Predisposed* to by the structure of particular parts of bone, and is more frequent in some bones than in others. Among the more constitutional causes, we may rank in the first line those cachectic conditions of the system that result from scrofula and syphilis, and those debilitated states of constitution that frequently follow upon scarlet or typhoid fever. In these various states, the bone may suddenly lose its vitality, more especially if the limb be subjected to slight accident, as concussion, or to exposure to some degree of cold. Sometimes the disease results from the vitality of the bone being destroyed by the extension of inflammation to it from the neighbouring tissues, as in some cases of whitlow, or by the bone becoming exposed by a neighbouring abscess.

Age exercises a predisposing influence on necrosis. It is not very common in young children, except as associated with caries of the bones of the hands and feet. When it does occur in the long bones in early life, it is usually very acute. In early adult age it is common in the long bones, more particularly the femur and the humerus, and then is usually the direct consequence of injury or of syphilis.

In other cases, simply as the result of old age, a bone or a portion of a bone dies suddenly, apparently by simple extinction of vitality, without any injury or other evident exciting cause. This I have seen occur in the lower ends of the humerus and of the tibia, giving rise to rapid and usually to fatal disorganisation of the neighbouring joints, or to death by abscess and constitutional irritation. This *Senile Necrosis* may be looked upon as the counterpart in the bone of senile sloughing or gangrene in the soft parts.

Acute febrile disturbance, more particularly scarlet and typhoid fevers, are not unfrequent exciting causes of necrosis in the young. Scarlet fever especially is apt to be followed by pains in the leg and about the knee, which at first appear to be of a rheumatic character, but which speedily run into abscess and are attended by all the symptoms of the most acute form of necrosis.

*Traumatic* causes frequently give rise to necrosis. Thus the denudation of a bone by its periosteum being stripped off, may lead to its death ; but, though the bone thus injured often loses its vitality, yet, if the membrane be replaced, its life may be preserved ; even when the bone is exposed, adhesions may take place between it and the neighbouring soft parts, or granulations may be thrown out by its surface, which eventually form another periosteum. Necrosis frequently occurs as the result of the detachment and denudation of a portion of bone in cases of bad compound fracture : so also the application of certain irritants, as the fumes of phosphorus, may occasion this disease, and hence it has been found that, in lucifer-match manufactories, necrosis of the lower jaw is a frequent consequence of the acrid fumes that are eliminated gaining access to the bone through carious teeth, or being applied to the exposed alveoli.

CHARACTERS.—In whatever way it originates, necrosis may affect the outer laminæ only of the bone, when it may be called *peripheral ;* or the innermost layers that surround the medullary canal may perish, and then it may be termed *central ;* or the whole thickness of a shaft, or of the substance of a short bone, may lose its vitality. The necrosed portion of bone, called the **Sequestrum,** presents peculiar characters, by which its nature may at once be recognised.

It is of a dirty yellowish-white colour, and has a dull opaque look, and, after exposure to the air, it gradually becomes of a deep brown or black tint; the margins are ragged, and more or less spiculated, and the free surface is tolerably smooth, but its attached surface is very irregular, rough, and uneven, presenting an eroded or worm-eaten appearance. This eroded appearance is well marked in sequestra that form in the interior of the terminal end of the femur in a thigh-stump after amputation, and is well illustrated by Fig. 14, where the lower smooth part is composed of the whole thickness of the bone, the upper rough and spiculated portions of the central portion of bone being separated from the outer layer, and hence being apparently eroded on their exterior. When the sequestrum forms in the cancellous structure, it is usually of a blackish-grey colour, irregular but somewhat ovoid in shape, as if the bony matter had been partially dissolved away; and here it is frequently conjoined with caries of the surrounding bone.

SYMPTOMS.—The symptoms of necrosis are divisible into two distinct periods. In the first, the bone dies and undergoes separation, and an attempt is made by nature at the expulsion of that portion of it which has lost its vitality. In the second period, the reparative processes for the restoration of the proper length and shape of the shaft are carried on. The particular character of the symptoms depends, however, not only on the stage, but also in a great measure on the seat and extent of the necrosis. In *acute* necrosis of the shaft of a long bone, the symptoms are extremely urgent. This form of the affection chiefly occurs in children and young adults. The patient is seized with a rigor, has great elevation of temperature, and complains of pain in the limb affected, which is often supposed to be of a "rheumatic" character. But the limb rapidly swells, becomes red, glazed, and œdematous; the outline of the bone is obscured by infiltration of the tissue, and the irritative fever is very severe. The severity of the symptoms will depend on the extent of the necrosis, whether it be superficial or invade the whole shaft. The abscess which forms is under the periosteum, between it and the bone. The pus is bacterial, often offensive when let out.

When the necrosis occurs in older persons, it is less acute, but in all cases it is ushered in by symptoms of local inflammation of a more or less intense and painful character; the skin becomes glazed, œdematous, and of a purplish-red tint; abscess, often of large size, and discharging great quantities of fetid or bloody pus, forms in the limb, and burrows widely, in proportion to the extent of the necrosis, amongst its areolar planes. If the suppuration be so extensive as to jeopardise life, as occasionally happens when the thigh is the seat of the disease, the patient sinking into rapid hectic, the suppurating cavity will gradually contract, leaving fistulous and sinuous tracts, often of great length and extent, leading to rough and bare bone, discharging a fetid and ichorous pus, and having their orifices surrounded by protuberant and glazed granulations. All these symptoms of inflammation, abscess, and widely spread suppuration, have for their ultimate objects the separation and elimination of the dead bone, and the proper formation of new bone as a substitute for that which has died. They are in the first instance occasioned by, and are not the cause of, the death of the bone. When a bone or a portion of a bone necroses, it becomes to all intents a foreign body. The adjacent soft tissues resent its presence, and endeavour to throw it off by an inflammatory action, just as they would if any extraneous substance, as a piece of wood, were thrust in amongst them. But the ultimate result of the action thus set up is not limited to the separation of the dead bone, but extends to the formation of material destined to repair the loss of substance occasioned by the separation and extrusion of the dead bone.

*Tubular or central necrosis* consists of the death of that portion of bone which lies in immediate contiguity to the medullary canal. It is usually the result of osteo-myelitis, and is common in stumps. (Fig. 14, vol. i. p. 47.)

In *peripheral necrosis* of the shafts of the long bones, as of the femur or tibia, the inflammatory symptoms just indicated are well marked, and the disease usually runs a rapid course up to the period of the formation and discharge of the abscess. In the case of *central necrosis*, the pain is usually more severe than in the former case, and is peculiarly deep-seated and throbbing, being especially intense at night. The limb becomes very œdematous, red, and glazed; the bone enlarges greatly, and abscess at last forms, which spreads widely in the planes of areolar tissue, undermining the muscles, and producing general destruction of the limb, the tissues of which become rigid and condensed, having sinuses leading down through them. On introducing a probe into the channels, the instrument passes through apertures into the bony case, termed **Cloacæ** (Fig. 408), at the bottom of which the dead bone will be felt rough and bare. Though this is the general condition that occurs in central necrosis, it occasionally but rarely happens that a small portion of some of the internal lamellæ of the bone dies, and, being included in a greatly thickened case of new bone, gives rise to symptoms of osteitis, or closely resembling those of circumscribed abscess of bone, but not to those characterising necrosis.

When the *whole thickness of a shaft* dies, the symptoms are always of a very acute kind, the extent and gravity of the inflammatory and suppurative condition being proportioned to the amount of bone that loses its vitality. The articular ends usually escape, though even these sometimes become affected, and the joints involved. The reason why the necrosis usually limits itself to the shaft is that its vascular supply is distinct from that of the epiphyses, which draw their blood from the articular arteries. The disease, therefore, in attacking them, would have to enter a new vascular area. When the *short cancellated bones* or the *articular ends of long bones* become the seat of necrosis, it commonly happens that the disease is far more chronic than in the other cases. In these cases the necrosis is associated with caries; the dead portion of bone being a small round mass lying in a vomica or carious cavity. The shaft is not implicated; abscess forms, which at first may not reveal its true nature, or, being preceded by continual pain, may be looked upon as a disease of rheumatic character. Suppuration at last occurs, sometimes rapidly opening into the neighbouring joint, and disorganising it with extreme constitutional disturbance; but more commonly it runs a very chronic course. On passing the probe down the fistulous openings that lead through the indurated and thickened soft parts, an aperture may usually be felt in the bone, at the bottom of which lies a necrosed mass not larger than a hazel-nut, surrounded by carious bone.

*Acute* necrosis especially attacks the shafts of the tibia and femur. In these cases violent and deeply seated pain occurs in the limb, which becomes generally inflamed, with much redness and great swelling. Abscess soon forms along the whole line of bone between it and the periosteum; and great constitutional disturbance ensues, which may lead to removal of limb as the only means of saving life. This form of necrosis chiefly occurs in young and cachectic subjects, usually as a sequel of a febrile attack, such as scarlatina or typhoid fever, or from exposure to severe cold. I have also seen it occur as a senile disease in the tibia, the humerus, and in the fibula of persons of an advanced age, from sixty-five to seventy-five years. In these patients the necrosis has set in suddenly, without any obvious exciting cause; but with intense pain, subperiosteal abscess, and inflamed œdematous swelling of the limb, which I have more than once seen mistaken for gout.

In acute necrosis, the disease usually stops short at the line of junction between the shaft and epiphyses. Hence, and for the reason already stated, the joints escape in the majority of instances. The prognosis of the case will mainly depend on this. If the joints escape, the sequestrum will separate, and a sound limb may result; if they become involved, amputation is inevitable.

On examination after the abscess has been opened, the bone will be found white, opaque, and dead-looking: the periosteum is detached, new bone is deposited, the surrounding parts are infiltrated, and, usually, suppuration has taken place around the bone through its whole length, if the patient be young, or in the circumference if he be old. In many cases, especially in children, the articular ends escape, the necrosis being confined to the shaft of the bone, which will be found to be detached from one or both epiphyses. To these the periosteum of the shaft, greatly thickened, still remains adherent, and will become the organ for the reproduction of the bone. In extreme cases, more particularly in old people, the articular ends are involved, and the joints secondarily affected and disorganised.

**Separation of the Dead Bone.**—The process of separation of the dead bone, and the formation of a new osseous tissue to supply the place of that which is necrosed, are most interesting phenomena. The separation of the dead bone, or its *Exfoliation*, is precisely similar to the mode in which a slough in soft tissues separates, the only difference being the time required. Inflammatory action is set up so as to form a true line of demarcation and of separation in the substance of the bone which is still living, and which is immediately contiguous to that which has lost its vitality. In this way a groove is gradually deepened around the edge of the sequestrum, by the absorption, or rather disintegration, of the earthy matter of the living bone, which is carried off by the pus formed in the course of the process; this pus, according to B. Cooper, contains 2½ per cent. of phosphate of lime. Along this gradually deepening line of separation, plastic matter is thrown out, from which granulations are formed that constitute a barrier, as it were, between the living and the dead bone, and, extending into the under surface of the sequestrum, become so implanted in the hollows and depressions which are there found, that this may continue to be firmly attached to the subjacent living bone after all osseous connection between them has ceased. This process of exfoliation may often be beautifully seen in the separation of the outer table of the skull in cases of necrosis of that bone. When occurring between the shaft and articular ends of a long bone, the process is precisely similar, though the line of separation is not quite so regular.

When once the dead bone has been detached by the formation of this line of separation, nature takes steps for its ultimate removal from the body. There is no evidence that it, in any circumstances, undergoes absorption to any great extent; although, as Paget and Billroth remark, that portion which remains in contact with proliferating granulations may undergo a certain amount of diminution. Miescher has shown that the detachment of small scales of bone may take place by the disintegration of their substance by a process of "insensible exfoliation," as he terms it. This process is a purely mechanical or physical one, and probably goes on in all dead bone that is in contact with pus, just as we see it take place in the ivory pegs used in the treatment of ununited fracture. This disintegration of the surface of the dead, together with the absorption of the margin of the living bone, in the formation of the line of separation, explains the fact that the sequestrum will always be found to be of much smaller size than the cavity in which it is lodged. The ultimate expulsion of the loosened or exfoliated sequestrum is effected by the growth of the granulations below it pushing it off the surface, or out of the cavity in which it lies. When the necrosed bone is *peripheral*, it will be readily thrown off in this way, although it may for a time be fixed and entangled by the mere pressure and extension of the granulations. When the sequestrum is *invaginated* within old or new bone, the process of elimination is necessarily very tardy, and may be difficult or impossible without surgical aid.

The *time* required for the exfoliation and separation of dead bone varies greatly. When it is superficial and small in size, a few weeks may suffice; but when the long or flat bones, as the femur, the scapula, or the ilium, are affected, the process may be extended over several years, and may terminate in the death of the patient from exhaustion before it is concluded; the constitution being harassed and worn out by hectic induced by profuse suppuration. Or the disease may fall into a chronic state, the limb becoming rigid, and the tissues much condensed, with fistulous apertures leading down to exposed but attached bone, and thus being a source of constant annoyance and suffering to the patient.

**Reparative Process.**—The reparative process adopted by nature for the restoration of the integrity of the bone, a portion of which has necrosed, varies according to the extent of the loss of substance. When the outer lamellæ alone are necrosed, new bone is deposited by the surrounding periosteum, and the depression that has formed on the surface of the old bone is filled up by a kind of cicatricial fibrous tissue, which ultimately ossifies. If the whole of the inner lamellæ of the shaft die, constituting *central necrosis*, the outer layers of bone become greatly consolidated and thickened by osseous matter deposited from the periosteum; in which, in the majority of cases, the circular or oval apertures termed *Cloacæ* form for the ultimate extrusion of the sequestrum (Fig. 408). In some cases, however, no cloacæ form, the dead bone continuing to be incased in the thickened outer layers. When the whole of a shaft dies, the reproduction takes place from various sources, principally from the periosteum, which is, indeed, essentially the organ of reproduction of bone, and perhaps from the medullary membrane, if that be left; these become thickened, vascular, and detached from the necrosed bone. That the periosteum takes the principal share in the reproduction is evident from the fact that, where it is deficient or has been destroyed, apertures (*cloacæ*) are left in the case of new bone; and if it be removed altogether, osseous tissue is either not thrown out at all, or most sparingly by the contiguous old bone, or by the epiphyses. The soft tissues, also, of the limb generally, if thick, as in the thigh, contribute to the formation of plastic matter, which gradually ossifies, and so tends to strengthen the new case; and, lastly, the articular ends of the old bone, still preserving their vitality, constitute most important agents in the reparative process, throwing out sufficient osseous matter to consolidate themselves firmly to the new shaft that is formed. The importance of the periosteum as the organ of regeneration of bone after the removal of the osseous structures, whether experimentally or surgically by resection, or by necrosis, has been conclusively demonstrated by Ollier of Lyons. This Surgeon has shown by many ingenious experiments, that in the lower animals reproduction of a whole bone may take place, as in the case of the radius in rabbits and pigeons, after it has been removed from within the periosteum; and that, if the periosteum be dissected off in slips, and twisted here and there between the muscles of the limb, new bone of various shapes may be formed on and by this partially detached membrane. He has further shown that, although in man, after operations and disease, new bone may be formed by the contiguous osseous tissue, and even by the neighbouring soft parts, yet the periosteum is essentially the organ of the regeneration of bone: thus confirming, by new and ingenious experiments, and by additional observations, the views that have just been expressed. The whole of a necrosed bone may, after separation, be reproduced by the periosteum. This is admirably illustrated by the annexed drawing, taken from the photograph of a preparation in the museum of Dr. J. Wood of New York. The whole of the inferior maxilla had separated as the result of phosphorus disease; the patient, a girl, lived for three years, the lower jaw having been reproduced as a perfect ring of bone, as represented in Fig. 409.

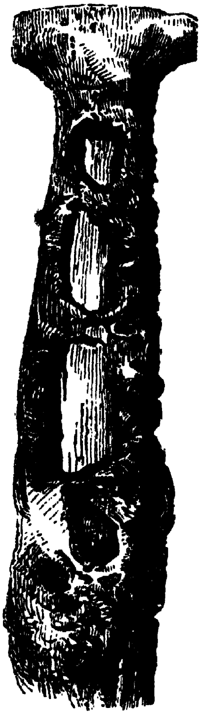


Fig. 408.—Central Necrosis. New Bone with Cloacæ; included Sequestrum.

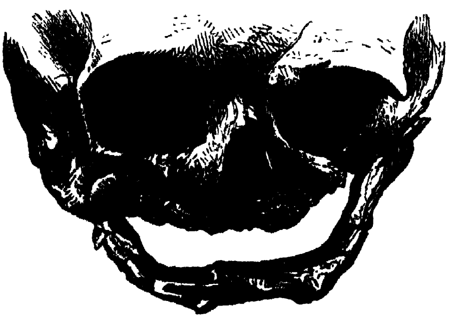


Fig. 409.—Reproduction of Lower Jaw after Phosphorus-Necrosis.

Thus it will be seen that the new bone is formed by the vascular and healthy tissues generally that surround the seat of disease, though in this reparative action the periosteum and the medullary membrane take the chief share, the epiphyses and old bone the next, and the areolar tissue of the limb but a very secondary and supplemental part. In acute necrosis, there is no time for complete reparative action to take place; but the periosteum will be found much thickened and vascular, separated from the dead bone, and occasionally lined with scales of new ossific matter, the first step towards the reproduction of a new shaft.

The new bone deposited on those parts of the surface of the shaft from which the scales of the old osseous tissue have been separated, or enveloping the sequestrum when the whole thickness of the shaft becomes necrosed, is at first rough, porous, cancellated, and very vascular; after a time it gradually becomes more compact and harder, at the same time that it assimilates in bulk and shape to the bone whose place it takes. The case of new bone, which necessarily exceeds in circumference the old bone, as this is included within it, gradually contracts both in texture and in size, becoming firmer and smaller after the removal of the sequestrum; and, the cloacæ closing so soon as all dead bone has been extruded, it eventually acquires the proper size and shape of the bone; the medullary canal even becoming lined by a proper membrane formed in it. In this way, restoration of the whole of the shaft of many of the long bones, such as those of the arm, forearm, and leg, will take place, provided always the epiphyses have been left untouched by disease. If one or other of these have been destroyed, all power of repair seems to be lost.

The new bone usually forms with a rapidity that keeps pace with the death and separation of the old bone. In acute cases of necrosis, in which amputation has been performed but a few weeks after the setting in of the disease, a thick layer of new bone will sometimes be found under the periosteum; but in some instances, when the whole of a shaft is necrosed, the new case is not completed, or has not become attached to the articular ends before these are separated from the shaft. In other cases, though complete, it has not sufficient strength to resist the contractions of the muscles of the limb; in these circumstances, it may spontaneously fracture—an accident that I have seen happen both in the femur and the tibia—or may become shortened or bent. In other instances, again, when the periosteum is deficient, new bone does not form (Fig. 410); but, as the sequestrum separates, the limb becomes shortened, loose, deformed, and useless.

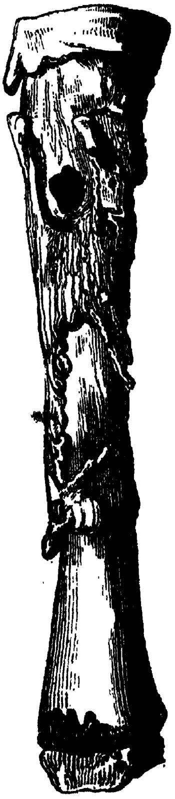


Fig. 410.—Necrosis. Deficient Formation of new Bone.

TREATMENT.—In the treatment of necrosis, the indications to be accomplished are sufficiently simple, though the mode in which they have to be carried out often requires much patience and skill on the part of the Surgeon.

The first point to be attended to is to *remove any constitutional or local cause* that has occasioned or keeps up the disease; unless this be done, it is clear that the whole of the rest of the treatment must be ineffectual. Thus, for instance, if the death of the bone appear to result from scrofula or syphilis, those conditions must be corrected. So again, if it arise in the lower jaw from the fumes of phosphorus, the patient must necessarily be removed from their influence; or, if it be threatened in consequence of denudation of bone, the best mode of prevention will be to lay down the flaps of integument, and so cover the exposed surface. Abscess should be opened as soon as it has fairly formed. The early and free opening of purulent collections is especially imperative when they are *subperiosteal.* In these cases the constitutional irritation occasioned by the confined pus is often so intense, more particularly in children of feeble constitution, that life is threatened, and can only be preserved by the evacuation of the pus from the midst of the tense structures between which it lies.

**Removal of the Sequestrum.**—After the cause has, in this way, been removed or counteracted, the separation of the sequestrum should be left as much as possible to the unaided efforts of nature. The less the Surgeon interferes with this part of the process the better ; for, as has justly been observed by Wedemeyer, the boundaries of the necrosis are known to nature only, and the Surgeon will most probably either not reach, or he will pass altogether beyond them. Here much patience will be required for many weeks or months ; and the utmost the Surgeon can do is to attend to the state of the patient's health, treating him carefully upon general principles, removing inflammatory mischief by appropriate means, opening abscesses as they form in the limb, and at a later period, supporting the patient's strength by good diet, tonics, and general treatment, calculated to bear him up against the depressing and wasting influence of continued suppuration, and of the irritation induced by the disease.

So soon as a sequestrum has been detached from the adjacent or underlying bone, by the proper extension of the granulating line of separation, the Surgeon must proceed to its removal. In most cases it is sufficiently easy, when the necrosis is superficial, to ascertain that this separation has taken place, as the flat end of a probe may be pushed under the edge of the detached lamina. When, however, the sequestrum is deeply seated, it is not always so easy to ascertain that the separation has occurred ; though, in the majority of cases, the introduction of a probe through one of the fistulous openings leading to the necrosed bone, and firm pressure exercised upon this, will enable the Surgeon to detect that degree of mobility which is characteristic of looseness. In other cases, however, the sequestrum, though completely removed from all osseous connections, still continues to be fixed by the pressure of the surrounding granulations, and by the extension of its spicula into the corresponding cavities of the new osseous case. This especially happens when the sequestrum is central and invaginated, and the cloacæ leading to it of such small size that but a limited portion of it is exposed. Here a more careful examination will be required ; and its looseness may sometimes be determined by pressing upon it with a probe in a kind of jerking manner, or by introducing two probes through different clôacæ, at some distance from one another, and alternately bearing upon the exposed bone with one or other of them. Then, again, if the sound elicited by striking the end of the probe against the sequestrum be a peculiarly hollow one, the detachment of the bone may be suspected. The duration of the disease, also, will probably throw some light upon the probable state of things inside the new case.

The separation of the sequestrum having been ascertained, the Surgeon must adopt measures for its extraction. If the necrosis be *peripheral,* all that is necessary is to make an incision down it through the soft parts, either by directly cutting upon it or by slitting up sinuses with a probe-pointed bistoury, and then to remove it with a pair of forceps, or to tilt it off the bed of granulations on which it is lying, by introducing the end of an elevator beneath its edge.

When the necrosis is *central*, the sequestrum being imbedded in the new case, or covered in by old bone, the operative procedures for its removal are of a more complicated character. The difficulties here consist in some cases in the depth from the surface, and in the obstacle offered by its passage through the soft parts; and in others, in the length and magnitude of the sequestrum in proportion to the small size of the cloacæ, and in the manner in which it lies in a parallel direction to these openings. In cutting down upon the bone, the Surgeon must be guided by the direction and the course of the fistulous tracks that lead to the principal apertures in the new case, the incisions being carried in the axis of the limb, and carefully directed away from large blood-vessels and nerves. In many instances, however, the hæmorrhage is somewhat abundant, in consequence of the injected state of the tissues furnishing a copious supply of blood, and their rigid condition preventing retraction of the vessels;

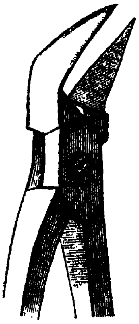


Fig. 411.

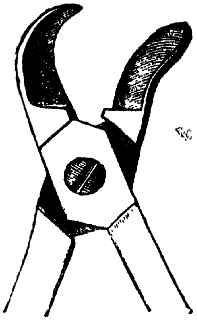


Fig. 412.

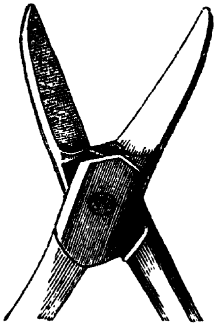


Fig. 413.

Cutting Pliers for removing Necrosed Bone.

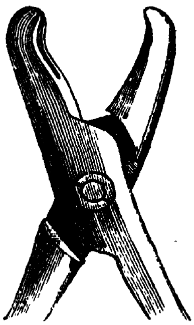


Fig. 414.

Gouge-forceps.

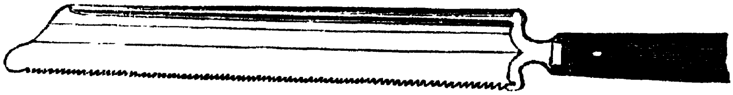


Fig. 415.—Straight Saw for removing Necrosed Bone.

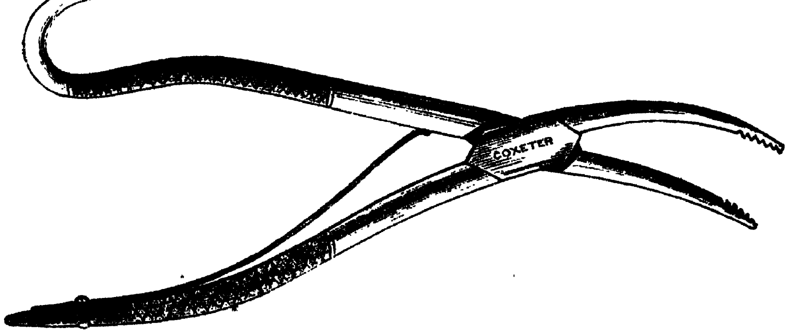


Fig. 416.—Necrosis-Forceps.

this, however, may be arrested by a tourniquet, or by the pressure of an assistant's fingers, and will soon gradually cease of itself. Esmarch's bloodless method will be found a great assistance in these operations. The bone having been freely exposed, it will sometimes be found that the cloacæ are of sufficient size to allow the ready extraction of the sequestrum. But in the majority of cases, this cannot be done at once, and the apertures must be enlarged, either with the gouge or the trephine, according to the density of the new case, and the amount of room required. Occasionally, when two cloacæ are close to one another, the intervening bridge of bone may very conveniently be removed by means of cutting pliers, of different shapes (as in Figs. 411, 412, and 413), or by means of a Hey's or a straight narrow saw having a movable back to stiffen the blade (Fig. 415), and space thus given for the extraction of the sequestrum. Very convenient pliers for this purpose are those represented in Fig. 414. They are made with gouge ends, and hence may be termed *gouge-forceps*. I have found them extremely serviceable in many operations upon the bones. Care, however, should be taken not to remove more of the new case than is absolutely necessary, as the aperture so made in it will not be filled up again by osseous matter, but will be closed by fibrous tissue, and thus the ultimate soundness of the limb might be endangered. For the extraction of the sequestrum, the most convenient instrument is a pair of strong necrosis-forceps, well roughened at their extremity, and straight or bent as the case may require (Fig. 416). Occasionally the sequestrum is so shaped and placed that it cannot be seized with this instrument; in these circumstances it will be useful to drive a screw-probe (Fig. 90) into it, by which it may either be extracted, or so fixed as to admit of seizure and removal by the forceps. In some cases, additional and convenient purchase may be given to the dead bone, by fixing a bone-forceps, such as is represented in Fig. 417, firmly into it. If the sequestrum be too large to be removed entire through the cloacæ, it may perhaps best be extracted piecemeal, having been previously divided by passing the points of narrow but strong cutting pliers into the interior of the bone.

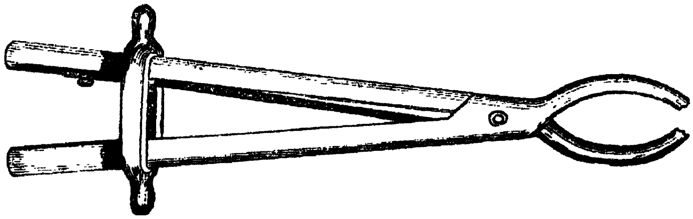


Fig. 417.—Bone-Forceps.

After the removal of the sequestrum, a smooth hollow cavity will be left in the new case, from the bottom and sides of which blood usually wells up freely, issuing abundantly from the vascular bone, and from the granulations lining its interior. Should this hæmorrhage be at all troublesome, pressure will always sufficiently arrest it. Lint must then be lightly introduced into the bottom of the wound, and the part elevated; a good deal of inflammation is frequently set up after the operation, but that must be combated on general principles. If the sequestrum have been a long one and have involved the greater part of the shaft of the bone, it may happen that the new case has not sufficient strength to maintain the limb of its proper length and shape, and that it will bend or break under the action of the forces and weight to which it is subjected. In order to prevent this accident, it will be necessary to put it up in light splints, or in a starched bandage. After the removal of the dead bone, the sinuses will speedily close, and the limb eventually regain its normal size and shape.

**Amputation.**—If the necrosed bone be so situated that it cannot be removed, occupying too great an extent and continuing to be firmly fixed; and if at the same time the patient's health have been worn down by constant discharge, and symptoms of hectic come on; or if the limb have generally been greatly disorganised by the morbid processes going on in it, recourse must be had to amputation as a last resource. It is especially in the lower third of the thigh-bone that these severe forms of necrosis occur, necessitating amputation of the limb. When necrosis affects the flat posterior surface of this bone above the condyles, a special source of danger occurs in the possibility of the sequestrum causing ulceration or wound of the popliteal artery. In cases of this kind, suddenly fatal hæmorrhage might occur. Should the hæmorrhage, though abundant, not be fatal, what course should the Surgeon adopt in such cases? Should he attempt to ligature the vessel, or should he amputate the limb? The line of practice must, I think, be determined by the condition of the limb itself and by the state of the patient's health. If these be both tolerably good, the limb not too much disorganised, and the powers of the system not too much reduced by hectic, an attempt might be made, by slitting up the sinuses, to expose and secure the popliteal artery at the seat of injury in it, and, by ligaturing it, to save life and limb. But should this attempt fail, as I have known happen, or should it not be thought prudent to make it, owing to the low state of the patient's strength, or the disorganised condition of the limb, amputation must be done without delay. As an idiopathic disease, necrosis of the tibia requiring amputation is rarely met with; but when it is the result of bad compound fractures, or of other serious injuries, removal of the limb may become imperative. In acute necrosis of the lower end of the thigh, or of the shaft of the tibia involving the contiguous joints, and attended by deep and extensive abscess of the limb, amputation is imperative.

**Resection** of the whole of the necrosed bone may be advantageously performed in such cases as those of the metacarpal and metatarsal bones, or in those of the forearm or leg, where sufficient stability of limb is secured by the remaining bone or bones to leave an useful member. The diseased bone may be thus removed in necrosis of the ungual phalanx occurring from whitlow, where, by the excision of the dead bone, the end of the finger may be preserved; also in necrosis of some of the metatarsal and tarsal bones, or those of the forearm, the inferior maxilla, and the fibula.

The remarks that I have hitherto made apply chiefly to necrosis of the long bones of the extremities. As there are a few special considerations connected with the necrosis of the flat bones, we will now consider these briefly.

**Necrosis of the Sternum, Scapula, or Bones of the Pelvis,** is an excessively tedious process, there being but very little tendency to the formation of the line of separation and the detachment of the sequestrum, which will continue bare, rough, and adherent for many years. Should it be so situated that it can be removed, it must be excised, even though not detached. When the ilium and pelvic bones are affected independently of the hip-joint, it is seldom that any operative measure can be employed with advantage : here we must leave the patient to the chance of the bone being at length so loosened as to admit of extraction. In some cases, however, if the disease be limited to a portion of the crest of the ilium, or to the tuber ischii, the dead bone may be removed ; although in these instances it not uncommonly happens that disease of a similar kind exists elsewhere about the sacrum or spine, that will eventually destroy the patient. In a case in which I removed a portion of the crista ilii for necrosis that was apparently confined to that bone, it was found, on the patient dying some weeks afterwards of erysipelas, that the lumbar vertebræ were also diseased. Of late years, considerable portions of the pelvis have been successfully excised for necrosis, as will be more fully mentioned when I come to speak of incision of the hip-joint. The tuber ischii, when affected, may readily be extirpated.

**Necrosis of the Cranial Bones** is of frequent occurrence as the result of struma or syphilis, or the two conditions conjoined. When met with in children, it is usually strumous, often occurring after measles or scarlet fever ; in adults it is usually syphilitic, though by no means invariably so, being sometimes the result of blows in people of otherwise healthy constitutions. There are four situations in which necrosis of the cranial bones may occur, viz., in the vault of the skull, the frontal bone, the temporal bone, or in the sphenoid and ethmoid bones. When idiopathic necrosis affects the vault, it is usually syphilitic ; when it occurs in the other situations, especially in the temporal bone, it is commonly strumous.

Three forms of necrosis affect the cranial bones. In one case, the outer table is alone affected : this perishes, separates, and exfoliates ; granulations then spring up from the outer surface of the inner table, and a process of repair is thus established. In the second form of the disease, the whole thickness of the skull necroses, separates from the dura mater and surrounding healthy bone in the usual way, and may be detached in large irregularly shaped pieces, sometimes of large size, occupying several square inches. In the third form, the necrosis is hard, dry, rough, and pitted or worm-eaten, penetrating through the diploë to the inner table, separating very slowly, and lasting an indefinite period.

*Results.*—In necrosis of the cranial bones, there is always the special danger of extension of morbid action to the membranes of the brain, and the consequent occurrence of inflammatory effusion within the skull, leading to convulsions, coma, and death. This danger is greatest when the petrous portion of the temporal bone is affected, as the structure of this bone is homogeneous, and the dura mater is continuous with the lining of the cavities by which it is perforated. Cerebral complication is less likely to occur when the frontal bone is the seat of disease, more particularly the lower part of this bone, where, by the intervention of the frontal sinuses, the anterior wall is altogether carried away from the inner table, and from all dangerous proximity to the membranes of the brain.

The *Signs* of necrosis of the cranial bones are very obvious. When the vault or forehead is affected, there is tenderness, with some puffiness, and gradual elevation of the scalp into an abscess. When this is opened, the necrosed bone may be felt or seen lying, dry and dark, at the bottom of a sinus or unhealed ulcer. When the petrous portion of the temporal bone is the seat of disease, there will have been ear-ache, followed by profuse fetid discharge from the ear, with perforation of the tympanum, escape of the ossicula auditûs, and deafness. When the sphenoid or the ethmoid is affected, deep pains in the head, persistent œdema of the eyelids, and fetid discharge from the nose, will reveal the nature and seat of the mischief.

The *Treatment* of necrosis of the cranial bones will vary according to the nature and the seat of the disease. In the dry pitted variety, exposing and scraping the diseased osseous surface or the application of a strong solution of sulphuric acid will often bring about a healthy action, provided the disease have not penetrated too deeply. Should there be reason to think that the inner table has been perforated, it will probably be safer to leave the case to the reparative processes of nature than to trephine. If, however, the anterior wall of the frontal sinus be the seat of the disease, or if the supraorbital ridge be affected, the dry and rough bone may be safely removed, as I have on more than one occasion had to do, by the application of the trephine in the first instance, and of the gouge in the other case. When exfoliating necrosis of the outer table, or of the whole thickness of the bone, affects the vault of the skull, the loosened plate may readily be lifted off its granulating bed by means of the elevator or forceps, after it has been fairly exposed.

Necrosis of the petrous portion of the temporal bone may be looked upon as an incurable disease, which is usually fatal from encephalitis. When the sphenoid or ethmoid is the seat of necrosis, little can usually be done by operative interference; though in the latter case portions of sequestrum may sometimes be extracted through the nostrils, and in one extraordinary case under my care in University College Hospital, I removed through the mouth the whole body of the sphenoid bone. The patient, a man aged forty-three, had suffered from syphilis for fifteen years, and from disease of the bones of the nose and upper jaw for three years. The anterior part of the hard palate was destroyed, and it was through the fissure so formed that I removed the bone. The fragment included the sella Turcica, and the roots of the pterygoid processes, but the clinoid processes could not be recognised. The patient had suffered from no cerebral symptoms except occasional headache and some loss of memory. He made a good recovery.

The **Patella** is rarely necrosed. I have, however, met with two instances of primary necrosis of this bone. One case occurred in an elderly woman. The disease came on without any evident external cause, commencing in the anterior part of the patella and gradually implicating the bone, until it became perforated, when rapid suppurative disorganisation of the knee-joint ensued, necessitating amputation. The other case occurred after simple fracture of the patella, in a man, and is described at p. 446, vol. i.

**Ribs.**—When the ribs are necrosed, abscesses and sinuses will often form to a considerable extent on the side of the chest. These must be laid open, and the diseased portion of bone scraped away by the gouge. In doing this, care must of course be taken that the adjacent intercostal space be not punctured by an unfortunate slip of the instrument—an accident that is best avoided by protecting the gouge well with the finger.

# CHAPTER XLVII.

## STRUCTURAL CHANGES IN BONE.

THE bones are liable to various structural changes, by which their size, shape, and consistence are modified, or in consequence of which they become the seat of tumours of various kinds.

HYPERTROPHY OF BONE.—Under this term two conditions may be included: viz., Sclerosis or Thickening of the Osseous Tissue; and Increased Length of Bones.

**Sclerosis** or hardening of bone sometimes occurs. It may attack several bones at the same time; and, in the long bones, may lead to filling up of the medullary and Haversian canals with bony substance, with some thickening of the bone. This condition is generally not capable of being recognised with certainty during life; and it may occur without being preceded by any signs of inflammation. It is allied in character to some of the forms of exostosis that will be presently described.

**Increase of Length of Bones.**—Allusion has already been made at p. 167 to the hypertrophy of bone which sometimes follows chronic osteitis. This increased growth of bone as a result of morbid conditions of that tissue, has been investigated by Stanley and Paget in this country, and by Langenbeck and others on the continent. It has been observed in connection with necrosis, osteo-myelitis, and chronic abscess: and also with chronic hyperæmia of the soft parts of a limb. Langenbeck, from his observations, concludes that morbid changes which give rise to irritation and hyperæmia of the osseous tissue lead, as long as the growth of bone continues, to an increase both in the length and in the thickness of bones; and that the increase of growth in length affects especially the diseased bones, but may also occur in a healthy bone of the same limb. Sometimes, as Paget has pointed out, the long existence of an ulcer of the integuments in a young person may produce thickening and elongation of the bone. When the femur undergoes elongation in this way, the inequality in length of the limb, unless the opposite limb be lengthened by artificial means, may lead to talipes of the foot of the lengthened limb or to lateral curvature of the spine. The tibia sometimes becomes elongated, while the fibula remains of its normal length: and in such cases the former bone becomes curved. The diagnosis of this condition from the curvature of rickets consists, according to Paget, in the marked elongation: in the absence of thickening of the ends of the bone, which are usually even more nearly equal in size to the shaft than in the natural state, on account of the thickening of the latter: and especially in the fact that "the rickety tibia is compressed, usually curved inwards, its shaft is flattened laterally, and its margins are narrow and spinous; while, in the elongated tibia, the curve is usually directed forwards, the margins are broad and round, the surfaces are convex, and the compression or flattening, if there be any, is from before backwards."

ATROPHY OF BONE.—This term comprises two conditions: one in which the bone is wasted, and another in which an arrest of growth occurs.

**Wasting Atrophy** occurs, as a natural result, in old age; the change that takes place in the lower jaw being a familiar example. In other cases it happens as a consequence of fracture; the nutritious artery of the bone having been torn across, and one of the fragments consequently receiving insufficient vascular supply. Atrophy of bone also commonly occurs from disuse, as is the case in old dislocations. In atrophy, the bone becomes thinner, lighter, and more porous than usual; the compact structure disappearing and the cancellous being expanded.

**Arrested Growth** of bones is an occasional consequence of disease. Its occurrence in rickets will be presently referred to. It may also be a result of various diseases of the epiphysis and joints, or of the resection of the epiphysis in children, and may follow the formation of cicatrices after burns in the neighbourhood of joints. The effect of paralysis on the growth of bone varies. It is common to see normal growth of the bones in limbs affected with paralysis of sensation and motion, even in young subjects, in whom the muscles are wasted; while in other cases the growth of the bone has been materially impaired, especially at the articular ends.

### RICKETS, MOLLITIES OSSIUM, AND SCROFULOUS OSTEITIS.

RICKETS is a disease of early life, never occurring after the age of puberty. In it, according to Virchow, the histological elements of the bone are normally constituted, but the earthy matter is deficient; so that the bone continues to be soft, flexible, and cartilaginous in structure, at an age when its tissue ought to have undergone proper consolidation. It appears to be atrophied, and the cancellous structure to be expanded into cavities of varying magnitude, which contain a brownish-red serous fluid. In consequence of the change of structure and the loss of firmness in the bones in this disease, considerable distortion of the body takes place. The *head* early appears large and expanded; indeed, Kilian states that rickets always first appear in the head, the forehead being especially protuberant; according to Stanley, this arises not from enlargement of the cranial bones, but in consequence of the want of development of those of the face; the head thus appearing large from its disproportion to the small face. The shape of the *limbs* is much changed and distorted, in consequence of their yielding to the pressure of the superincumbent weight; the pelvis becoming contracted, and the thighs and legs bent either forwards or outwards. Humphry and Langenbeck have called attention to shortening of the bones in rickets. Humphry says that the humerus and femur are one-fourth shorter in rickety subjects than in healthy individuals of the same age; and Langenbeck regards this shortening as more constant and more characteristic of rickets, than bending and deficiency of earthy matter. The *joints* usually appear swollen, from the articular ends of the bones being enlarged. In early life the *chest* will be observed to be deformed in a peculiar manner, being narrowed above, where the upper ribs are contracted and pressed in, but expanded below, apparently from the weight of the abdominal viscera, which are often tumefied, and in these cases drag on the lower ribs. In rickety children there is a general delicacy of appearance, and occasionally a strumous habit of body, though, according to Rokitansky, they are not usually tuberculous; if they live, however, past the age of puberty, they may eventually become sufficiently powerful in frame.

The *Treatment* of rickets must be conducted on the same general principles that guide us in cases of scrofula; pure air, good food, and plenty of it, regular exercise, and the administration of tonics, especially cod liver oil and the preparations of iron, with scrupulous attention to the general habits of life of the child, will generally improve his condition to the utmost limits compatible with the powers of his constitution, and will, by improving the nutrition of the system, tend to the more healthy deposition of osseous matter. In some cases, the administration of lime-water with milk seems to be of service in supplying those elements that are required by the system. It is of much importance in preventing deformity in these cases not to allow the child to walk or stand much, but to let it take exercise in donkey-panniers or hand-chairs, and to support those limbs that have a special tendency to become excurvated, with properly constructed steel supports, which will be found of much use, provided they are not too heavy, or interfere with the action of the muscles. Methodical friction should also be employed, so as to stimulate the muscles; as these become more vigorous, their osseous attachments have a tendency to become stronger.

MOLLITIES AND FRAGILITAS OSSIUM—OSTEOMALACIA.—A most destructive and dangerous disease of the bones, characterised by softening and fragility of the osseous structure, is occasionally met with. This affection has been studied with much attention by Curling, Solly, Stanley, MacIntyre, and Litzmann; and it is principally from their labours that we are acquainted with the principal facts relating to it.

In this disease the bones are bent, their epiphyses swollen, and their shafts broken in various parts of the body. Occasionally, though very rarely, only one is fractured; but in other cases, as in Tyrrell's, there may be as many as twenty-two fractures, or, as in Arnott's, thirty-one. These fractures are unattended by any attempt at the formation of callus. The body becomes singularly and distressingly distorted. On examining the bones after death they will be found to be light, soft, and somewhat gritty—bending, and at the same time readily snapping across; occasionally they are expanded and thickened. This happens especially with the skull, which becomes often considerably increased in substance. On cutting the bones, which are soft and yield something like cartilage, the knife usually encounters a kind of gritty substance. On making a section of the bones they appear of a deep reddish-brown or maroon colour, and will be seen to contain cavities of various sizes, small or large, but always of a circular or oval shape, and generally filled with an oily red and grumous fluid, though sometimes they contain clear serum. On examining this red grumous matter under the microscope it shows a cell-development; hence Solly remarks that it is probably an adventitious morbid product, and not simply fatty matter altered by the effusion of blood into it. Dalrymple has shown that this material is composed of granular matter, nucleated cells, and a few caudate corpuscles: he therefore believes it to be a disease essentially malignant in its nature, but differing from other malignant affections; for, "instead of progressively reproducing and developing themselves without limitation, the new and morbid formations which replace the original and sound structure seem to have been at an early stage of their existence removed by absorption and carried out of the system" (MacIntyre). It is, however, more reasonable to consider with Virchow that this condition merely represents a retrogade conversion of osseous substance into medullary tissue, which under certain circumstances appears as an extraordinarily soft and very vascular structure, rich in cells; or as a gelatinous and semi-fluid substance. An excessive production of medullary spaces takes place by absorption of the laminated structure, whilst the osseous corpuscles either become converted into the new cells, or disappear. Paget suggests that two diseases are included under the title of mollities ossium; one, more common in England, marked by fatty degeneration, but distinct from the condition in which atrophy is accompanied by fatty deposit: and another, the *osteoporosis* of German writers, more common in France and Germany, in which there is a simple removal of the earthy matter. He believes that the former affects especially the bones of the extremities, the latter those of the trunk.

In chemical compositions, the diseased bone has been found by Leeson to be composed of 18·75 animal matter, 29·17 phosphate and carbonate of lime, and 52·08 of water in every hundred parts.

*Cause.*—The cause of the complaint is obscure. It would appear that it is frequently connected with a rheumatic tendency; as, in every case recorded, the affection has been preceded or accompanied by severe pains, or distinct rheumatic attacks. In some instances the patients have been affected with syphilis. In a majority of cases it appears to have a connection with the childbearing state: Paget believes that it is simple osteomalacia, rather than fatty degeneration, which occurs in these circumstances. It most commonly, though not invariably, occurs in females, as pointed out by Kilian. Among 131 patients whose histories have been collected by Litzmann of Kiel, there were 85 females, in whom the disease either appeared during pregnancy and labour, or was modified in its course by these conditions. Of the remaining 46 patients, 35 were females, and 11 males. It most generally attacks adults, having been observed in few cases under the age of 20: and it may occur even at very advanced age.

The *Seat of the Disease*, according to Litzmann, varies according as it occurs within the childbearing period, or independently of this. In 85 childbearing women, the whole skeleton was affected in 6 cases only, and all except the bones of the head in two; while in 46 other cases, all parts of the skeleton were diseased in 21, and all the bones except those of the head in 6. The percentage of the occurrence of the disease in various parts is shown in the following table:—

| | 85 child-bearing women. | 46 other cases. |
|---|---|---|
| Pelvis | 96 | 87 |
| Spinal Column | 54 | 87 |
| Chest | 31 | 80 |
| Lower Limb | 17 | 78 |
| Upper Limb | 12 | 62 |
| Head | 8 | 52 |

In childbearing women the disease appears to have a remarkable predilection for the pelvis; it is probable, however, that a careful examination of all the bones has not been made in all cases.

*State of the Urine.*—In all cases that have been recorded, the urine has been seen to contain large quantities of earthy matter. Solly pointed out that this is phosphate of lime, which has been absorbed from the bone, and thrown out by the kidneys in the urine; and sometimes the elimination of this matter is so abundant that it forms, as in one of the cases which he relates, a solid calculus, clogging up the interior of the kidney. In MacIntyre's case, the earthy matters of the bone appear to have been, in the first instance, absorbed, and carried off from the kidneys by the urine; but afterwards an animal matter, of a peculiar and apparently previously undescribed character, was discharged in abundance.

*Symptoms.*—These are, in the early stages, extremely obscure and insidious. The patient complains, in the first instance, of wandering pains about the limbs and trunk which assume usually a rheumatic character, though they have been observed to be of a much more severe, persistent, and intractable nature than those that occur in any form of rheumatism. The patient becomes debilitated, unfitted for exertion, and emaciated. Spontaneous fracture now occurs in some bones under the influence of the most trivial causes; others become bent, and the body consequently greatly misshapen and distorted. The urine presents some of the abnormal characters above described, and death eventually results from general exhaustion.

*Diagnosis.*—The diagnosis of this affection has to be made in the early stages from *rheumatism.* This is not always easy, and, indeed, is at first impossible; but after a time, when the peculiar phosphatic condition of the urine and the fragility or distortions of the osseous system manifest themselves, the true nature of the affection becomes apparent. With *rickets* it cannot possibly be confounded, as rickets is a disease of childhood, and osteomalacia is peculiar to adult or advanced life. The severe pains and the great distortion, with the tendency to spontaneous fracture which is observed in this disease, are never noticed in rickety children.

*Treatment.*—With regard to treatment, but little can be done; the administration of tonics, and a general supporting plan of treatment, may arrest for a time the progress of this terrible affection; but when once it is declared, it usually progresses from bad to worse, and at last destroys the patient. Opiates may be employed to allay the pain, and in MacIntyre's case some temporary advantage appeared to result from the administration of alum; but no remedy has appeared to exercise any continuous advantage in this complaint, which, there is reason to believe with Solly, is truly malignant.

A form of osteomalacia, giving rise to excessive liability to fracture, is sometimes met with in the *insane.* In such cases, numerous fractures of bones, especially the ribs, have been found, and in many of them repair has taken place.

SCROFULOUS OSTEITIS.—The scrofulous affections of bone constitute an important section of the diseases of this tissue in children and young people, who are the subjects of this diathesis. They have been for the most part described as the results of the deposit of tubercle in this tissue, but are almost always connected with chronic inflammatory processes of a low type, the exudations of which undergo caseation, whilst the true grey granulations are but rarely found. The characteristic feature of this disease is the production of chronic osteitis and periostitis, circumscribed abscess, caries, and necrosis. These changes most commonly take place in the cancellous tissue, and consequently affect the epiphyses of the long bones more than the shafts, and frequently lead to implication and destruction of the contiguous joints. In the short bones, as those of the tarsus, they commonly lead to caries and necrosis; and affecting, as they often do, the bodies of the vertebræ, very frequently give rise to some of the most destructive diseases of the spine, attended by the formation of large lumbar and iliac abscesses. Under the influence of this diathesis, a low form of inflammation is readily established in the osseous tissue, as the result of any slight exposure to external violence or change of temperature; and this rapidly leads to caries, with the formation of curdy pus in which masses of softened tissue may be seen. If this destructive action take place with great rapidity, portions of the bone will be found to necrose in small masses, which lie at the bottom of these carious cavities, as may commonly be observed in some forms of strumous caries of the os calcis and head of the tibia. These scrofulous vomicæ undermine the overlying articular cartilage, and thus opening up the interior, give rise to the most destructive suppurative disorganisation in it. Fig. 418 is a representation of one of these vomicæ in the head of the tibia, their most common seat. When the inflammation has been of a more acute character, it may cause disintegration of the whole of the articular end of a long bone, with separation of the epiphysis. These destructive changes may take place with great rapidity; I have seen them happen in a lad, whose thigh I amputated for acute strumous infiltration of the lower end of the thigh-bone, in less than a month from the first occurrence of the complaint; the patient, at the time of the operation, being nearly exhausted by hectic, induced by the abundant discharge from the diseased bone, and from immense abscesses in his thigh.

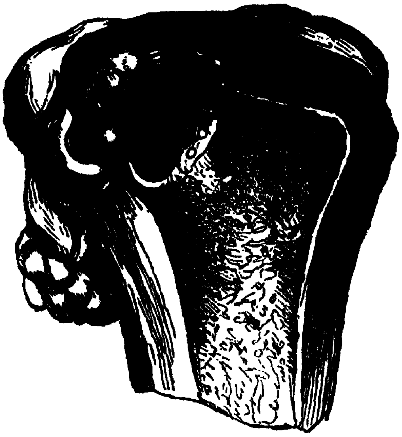


Fig. 418.- Scrofulous Vomica in Head of Tibia.

When, on the contrary, the changes are limited to a very small area in an otherwise healthy bone, the diseased portion may, as it undergoes softening, dispose to the occurrence of circumscribed abscess, at the same time that chronic thickening and condensation of the surrounding bone takes place. It is in consequence of this condensation of the peripheral portion of the bone by the deposit of fresh layers of osseous tissue under and by the inflamed periosteum, and the difficulty that the contents of the abscess necessarily experience in traversing the hypertrophied osseous structure, that the diseased product is apt, when deposited in the vicinity of a joint, to work its way through the cartilages into the cavity of the articulation; as on this surface no fresh deposit nor condensation of osseous tissue can take place, and consequently no additional obstacle is offered to the outward progress of the inflammatory products, or rather of the curdy matter into which they have become transformed.

The existence of these changes in the osseous tissue thus not only gives rise to destruction of the bone and adjacent articulations, &c., but may occasion inflammation and extensive suppuration in the neighbouring soft parts; indeed, some of the largest chronic abscesses that form in the body, those connected with diseased dorsal or lumbar vertebræ, owe their origin in the majority of cases to the deposition and disintegration of these lowly organised products in the bones. When once caries has been established in a bone, and the osseous boundaries containing the *débris* have become perforated by the accompanying plastic infiltration and abscess and sinuses of the soft parts, &c., these conditions will continue in a permanent manner; the fistulous tracks leading down to the bone, and the cavities in it, remaining open so long as any unsound matter is left at the bottom of them; and in this way the patient may eventually be exhausted by the copious and continuous discharge from the osseous vomicæ. In some favourable cases as the result of natural processes, and in others from those operations that the Surgeon performs for caries, the whole of these products may be disintegrated, and thus eventually eliminated, a true vomica being left in the bones, or scooped out by the gouge; and then the sinus, whether in the soft parts or in bone, having no longer this kind of foreign body lying on its bottom, gradually closes—not by the contraction of its osseous walls, which is of course impossible, but by the deposition of a fibrous tissue by which the cavity is occluded.

*Pathology.*—Nélaton has devoted special attention to the pathology of these affections, to which he applies the term tubercular, and with which he classes the only variety to which the name properly belongs, viz., that derived from the deposit of grey granulations in the osseous tissue. He describes two forms of tubercle in this situation; the first is the *encysted* variety, which occurs in the form of small masses, of an opaque white or yellowish colour, contained in a cyst, which is soft, vascular, and spongy, apparently of a cellular structure. This variety is stated by Nélaton to be the most common. I have certainly not found it so, but have most frequently met with the infiltrated opaque tubercle. The other form in which tubercle occurs, according to Nélaton, is an *infiltration* into the cancellous structure of bones. This may be in the form of semi-transparent granulations of a greyish or rosy tint, opalescent and slightly transparent; occasionally these granulations are firm, so as almost to resemble cartilaginous deposits in the interior of the bone. The osseous structure, in the midst of which this kind of tuberculous matter is deposited, does not appear at first to undergo any material alteration. Tubercle may also be infiltrated as opaque puriform matter of a pale yellow colour, soft, and without vascularity (Fig. 421). The osseous tissue, under the influence of this disease, often becomes, as Nélaton observes, more condensed than natural, the cells being obliterated so as to resemble the compact substance of bone. In some cases it may continue thus chronically thickened and indurated; but in other instances the tuberculous inflammation will give rise to rapid and destructive inflammation of the surrounding osseous tissue, which becomes excessively vascular, and crumbles down into a carious state, with some necrosed masses intermixed. In other instances, as is not unfrequently observed in some of the forms of caries of the spine, or of white swelling, slow suppuration takes place in the interior of the bone; and on the sides or in the centre of the abscesses thus formed, hardened and white ivory-looking masses and knobs of osseous tissue may be seen to be deposited; these apparently consisting of tuberculous bone that has undergone some special modification of structure. All these changes, with the exception of that described as the grey infiltration, appear to be due rather to chronic inflammatory changes, accompanied by an impaired nutrition and imperfect attempts at repair, than to the development of a distinct new formation. Virchow proposes the name of scrofulous osteomyelitis, as more truly expressing the conditions present in these cases than that of tubercle, which he would limit to the following variety.

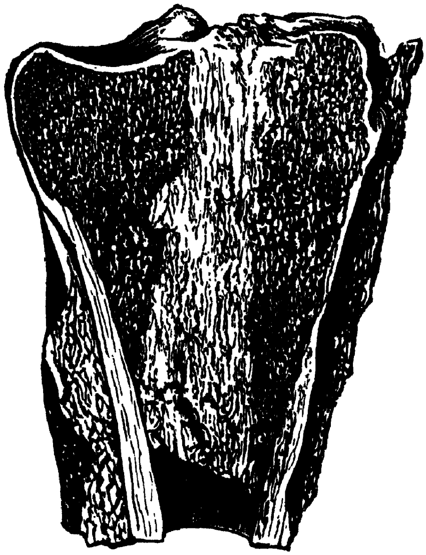


Fig. 419.—Scrofulous Osteitis of Tibia.

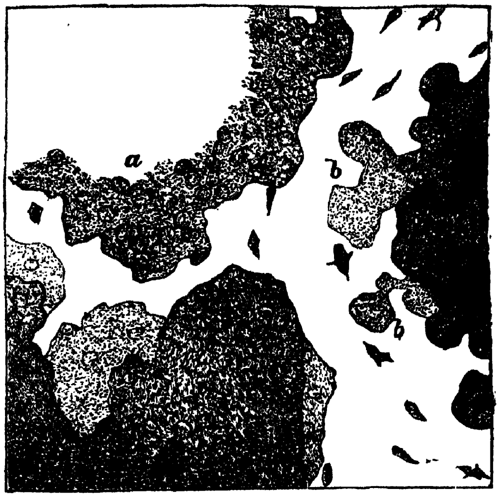


Fig. 420.—Carious Bone from a Case of Scrofulous Osteitis of the bones of the Skull in a Child. At *b* are seen the so-called Lacunæ of Howship; the material filling the dilated Cancellous Spaces *a* is more or less cheesy granulation material.

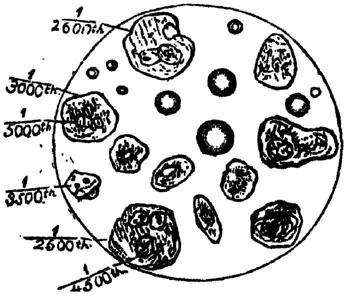


Fig. 421.—Cells of Osseous Tubercle.

Tubercle of bone, in the limited sense in which this term is here employed, is undoubtedly a rare affection. True miliary tubercle in the form of grey granulations, which undergo cheesy changes, and lead to softening and necrosis of the parts around, is occasionally found in the cancellous tissue of the epiphyses, or more commonly in the spongy structures of the bones of the tarsus (Billroth). It is absolutely impossible to form any exact diagnosis of the nature of the changes going on in the bone, which can only be determined by an examination of the conditions of the other organs. There can, however, be no doubt that the bones of young people, the subjects of tuberculous disease in the restricted sense of the term, are very liable to become affected with caries from very slight causes. In fact, in both struma and tubercle, nutritive functions are imperfectly performed, and tissues formed under these influences readily suffer when put to any severe trial.

*Treatment.*—The treatment of tubercle of bone resolves itself into that of its effects. As its existence cannot be recognised except by the changes which it induces in the bone, the treatment must be directed exclusively to these. Thus, if it occasion circumscribed abscess, this must be opened: if caries, the diseased cavity and tissue must be scooped out, or removed in accordance with the principles already laid down; and if disease of the neighbouring articulations result, it must be managed in the way that will hereafter be explained.

It is of importance, however, to recognise the dependence of these various affections of the bones on a scrofulous or tuberculous constitutional state, as it is specially necessary in these conditions that suitable measures should be adopted for the removal of the cause. Thus, good food, sea air, the administration of iron, of the iodides, and cod-liver oil, will form most important elements in the treatment; and without these, indeed, it cannot be brought to a successful termination. The progress of these cases is generally excessively tedious. Stanley gives two years as the time required for a strumous bone to recover itself; and in very many instances this period may even be exceeded. In this, as in all other chronic inflammatory affections of the bone, it is of considerable moment to continue the means of cure until the disease is fully recovered from; for relapse will occur with special readiness in the tubercular affections, if the patient be allowed to use the diseased limb or part too soon.

Deposits of tubercle in bone may serve as centres whence general tuberculosis may spread. Hence the importance of their free removal by amputation, excision, or gouging of the diseased bone, according to the extent and the situation of the tubercular infiltration of or deposit in it.

### TUMOURS OF BONE.

EXOSTOSIS.—By exostosis is meant the growth of a bony tumour from some of the osseous structures of the body. The causes that immediately give rise to this disease are usually extremely obscure. There can be no doubt that in some instances it is hereditary; but, in general, it occurs without any distinct or appreciable exciting cause. It is chiefly met with in the young, developing itself about the age of puberty. Exostosis appears to originate in two ways; being either primarily formed and deposited as true bone; or in other cases being the result of the ossification of an enchondroma.

Exostoses may be single or multiple. They are usually situated in or near the epiphysis. When multiple, they commonly occur at the insertions of tendons.

Exostoses are of two kinds—the one hard and compact, the other softer and more spongy. The hard, or **Ivory Exostosis**, is a structure that differs both in appearance and composition from true bone. It is extremely compact and white, having a granular section closely resembling that of ivory, and presenting somewhat radiating fibres, but possessing a true bony structure, Haversian canals, lacunæ, and lamellæ. In chemical composition, it is found to differ from healthy bone in containing more of the phosphate and less of the carbonate of lime, and also in the proportion of animal matter being smaller. This kind of exostosis principally grows from the flat bones, and, as it is generally of small size, seldom produces much inconvenience, unless it project into and compress important parts. Thus, Cloquet relates the case of a tumour of this kind growing from the pubic bone, and perforating the bladder; and it is occasionally found to project into the orbit, or from the inner table of the skull, upon the brain. When exostosis is left to itself, it may become stationary after a time. In some instances it has been known to necrose, and to slough away, as it were, from the parts in which it has been situated. Of this termination Hilton and Boyer relate instances.

The **Spongy, Cancellous, or Cellular Exostoses** grow rapidly, often attain a considerable size, and are very commonly multiple. Exostoses of this form are primarily enchondromatous, and are found to be covered with a thin layer of cartilage, which appears to precede their development. They are usually pedunculated. When numerous, they will often be found to be somewhat symmetrical in their arrangement. Not unfrequently they stretch across from one bone to another, bridging over joints, and thus giving rise to ankylosis: in shape they vary greatly, sometimes being globular, at others spinous; in structure and chemical composition they are identical with cancellated bone. Their most common seats are, according to Billroth, the tibia, fibula, and humerus. The structure of exostoses has been described and illustrated, Vol. I., p. 756.

The *Symptoms* of exostosis are simply those produced by a hard, thick, and slowly growing tumour, connected with a bone and pushing forwards the soft parts covering it. In many cases it produces serious inconvenience by its pressure, either upon neighbouring organs or mucous canals; or it may occasion ulceration of the skin lying above it. In some cases, exostosis of a long bone may be connected with an arrest of development of the bone from which it springs. It would appear as if there were a perversion rather than an absence of proper ossification in these cases. Thus I have seen the lower third of the ulna completely arrested in its development by the formation of the exostoses at the lower part of the middle third, the bone being permanently shortened and dwarfed below this point.

*Treatment.*—If an exostosis be so situated as to occasion inconvenience or deformity, it will be necessary to remove it; and as it is a local disease, there is no fear of its return, provided this be fully done. If, however, the whole of it be not taken away, it may grow again; and Stanley accordingly recommends that if it be so situated, as upon the skull, that its base cannot be extirpated, potassa fusa or nitric acid should be applied to the part that is left, so as to produce exfoliation of it. The removal of these tumours is best effected by a Hey's or a chain saw, or cutting pliers. In some situations, as when close upon joints, or springing from the cervical vertebræ, they cannot be interfered with; and in other cases, as occasionally happens in the neighbourhood of the orbit, their density and hardness may be such that the saw can scarcely work its way through them. There is one variety of exostosis which deserves special attention. It is that form of the disease which springs from the upper surface of the ungual phalanx of the great toe. It forms a small rounded mass, usually about half as large as a cherry, projecting under or beyond the nail, and giving rise to much pain and inconvenience in walking. Dupuytren, who first described this peculiar variety of the disease, has pointed out the treatment proper for it, which consists in exposing it by a double elliptical incision, and cutting it off with the scalpel, or a small pair of pliers, without amputating the toe.

There is a species of bony growth, called *Osteoma*, consisting of an uniform elongated mass of new bone, deposited on some of the osseous surfaces, somewhat resembling a node, and differing from ordinary exostosis in not being pedunculated. This does not admit of removal, and is not amenable to any treatment. The term osteoma is also sometimes applied to exostosis in general.

ENCHONDROMATOUS OR OSTEO-CARTILAGINOUS TUMOURS are often met with. These have already been described when speaking of enchondroma and its pathology (p. 753, vol. I.), and need not, consequently, be more than adverted to here. They usually require resection or amputation of the affected bone, according to the attachments and size of the growth ; but Stanley states that in some cases, where the cartilaginous tumour of bone is of small size, it may be influenced and eventually dispersed by the local application of iodine and mercury.

CYSTIC TUMOURS of bone of various kinds are commonly included under the terms *Osteo-sarcoma* and *Spina Ventosa.* The former term has also been occasionally applied to various other solid growths, whether fatty, fibrous, gelatinous, or cartilaginous, as well as to various kinds of malignant tumour springing from bones ; and hence much confusion in the pathology of these affections has been caused.

*Structure.*—The cystic tumours of bone have been well described by Nélaton. They consist of cysts, having various kinds of fluid and solid contents. The cysts may be unilocular, and these are commonly filled with solid matter ; or multilocular, and they then contain fluid. The *solid masses* are usually of a fibro-cellular or fibro-cartilaginous character, filling up completely the cavity in which they are situated, and often attaining a very considerable size. They occur principally about the jaws, and articular ends of long bones, especially the humerus, the femur, and the tibia. The *cysts with fluid or semi-fluid contents* attain a much larger size than the last, being often met with as large as a cocoa-nut or a fœtal head. On section, they are found to be composed of multilocular cysts, each cavity having distinct walls, and often communicating with others. The fluid contained within these cysts is of various characters, thin and serous, sero-sanguinolent, viscid, or dark coloured, often associated with masses of fibrous tumour, appearing as if it proceeded from the central softening of these large growths. The same situations are affected by the compound as by the single cysts, but they are also met with in the shafts of long bones. From whatever part they proceed, their walls are composed of expanded bone, not uniformly thinned, but thickened and nodulated at various parts, whilst it is perforated at others (Fig. 422).

These cystic tumours principally occur in adults, being rarely met with in children. They constitute smooth, round, or oval growths, increasing slowly, but steadily, with little or no pain ; the skin covering them being of the normal colour, and the veins usually blue, enlarged, and tortuous. When a certain size has been attained, so that the shell of bone is expanded into a very thin lamella, and before it is perforated, pressure on the tumour occasions a peculiar crackling or rustling noise, like that produced by pressing together a broken egg-shell, or the crackling of tin-foil. Under this, the elasticity or even semi-fluctuation of the tumour may be felt. This fluctuation is particularly marked after a time, when the osseous envelope has become still more expanded, or is partially or wholly absorbed.

*Treatment.*—When the contents of the tumour are fluid or semi-fluid, it must, if large, be treated in the same way as solid growths are: but if it be small, or if of moderate size, so as not to have materially affected the integrity of the bone, it may suffice to remove one side of the wall of the cyst by the trephine or by excision, and then the cavity may be stuffed with lint, and allowed to granulate, and its walls to contract. This plan has proved especially successful in some of the cystic tumours of the lower jaw; and I have had occasion to practise it with success in a small cyst forming in the outer condyle of the humerus.

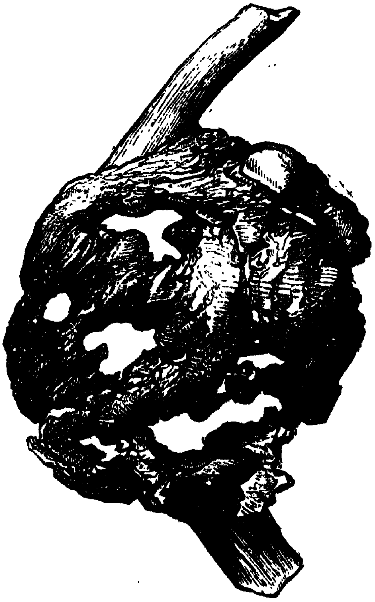


Fig. 422.—Expansion of Lower End of Femur by Cystic Tumour.

MYELOID AND SPINDLE-CELLED SARCOMATA are not unfrequently met with at the articular ends of the long bones (Fig. 423). They always develop in the cancellous structure; sometimes spontaneously, at other times as the result of a blow or other injury. Even when involving the shaft of a bone, they usually commence in the central portion of the osseous tissue, and expand outwards. All the long and many of the flat bones are liable to this form of disease. It is most common, perhaps, at the lower end of the femur, and the head of the tibia; in the head of the humerus, and the lower end of the radius; in fact, in those portions of bone where there is most cancellous structure. In the jaw and the scapula it also occurs; and I have amputated the thigh for this disease in the fibula of a lad.

The disease is local in its development and earlier stages, but has a tendency to recurrence after removal, especially if the whole of the affected bone and infiltrated muscles be not extirpated. Its malignancy is proportionate to the rapidity of its growth; and the more rapid this is, the greater will be the probability of recurrence and of secondary deposits in internal organs. Recurrent myeloid, after imperfect extirpation, is always softer, darker, and more malignant in appearance and in action than the primary deposit.

A myeloid tumour, developing in the articular end of a long bone, may burst into the neighbouring joint and fill this up with its softened mass. It does this by pushing before it the incrusting cartilages of the joint. These are not destroyed or invaded by the disease; but, the bone by which they are supported being disintegrated, broken down, and destroyed, they necessarily separate and lie loosened upon the morbid mass.

The structure of myeloid tumours has been described and illustrated (Vol. I., p. 770). The accompanying drawings (Figs. 423—428) afford examples of it in its primary and recurrent forms when occurring in bones.

*Treatment.*—Tumours of bone, however simple in their character, are necessarily entirely beyond the reach of constitutional or local resolvents, and Surgeons have consequently been in the habit either of gouging or cutting out the tumour, or of removing the whole of the bone from which it springs, either by amputation or excision ; and in malignant disease of bone this is doubtless the only safe course. But in non-malignant tumours of bone the case is different, and Sir James Paget has adduced several instances to prove that the partial operation may be done with perfect success so far as avoidance of recurrence is concerned, the tumour being enucleated or shelled out of the case of bone in which it is lodged. The great difficulty, as he justly observes, consists in the diagnosis between the benign and malignant tumour. The points to which he specially directs attention are the following. 1. The age of the patient. If below puberty or past middle age the tumour is probably malignant, unless it be a common exostosis. 2. The age of the tumour. If more than of two years' duration, it is probably not malignant. 3. If a tumour of bone have doubled its size in six months, not being inflamed—if it be situated on the shaft of a long bone—and if the lymphatics be enlarged, it is probably malignant or recurrent. If a concurrence of conditions point to the non-malignancy of the tumour, and if it be found to have grown from within the bone and to have expanded this in the form of a shell over its surface, then enucleation should be attempted ; if, on the other hand, the symptoms point to its malignant nature, amputation or excision of the whole bone must be practised.

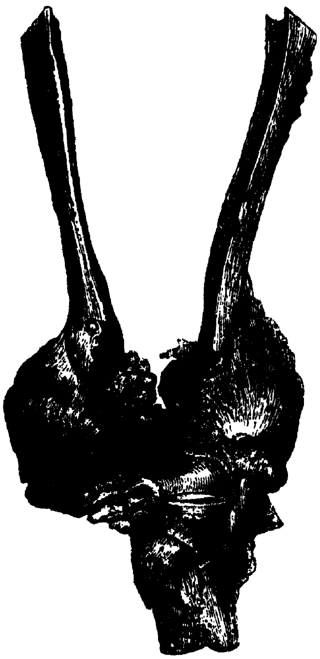


Fig. 423.—Myeloid Tumour of Lower End of Humerus of two years' growth, following Fracture of the Condyles.

HYDATIDS.—Cavities are occasionally, but very rarely, found in bones, in which large numbers of hydatids are lodged ; according to Stanley, both the acephalocyst and the cysticercus cellulosæ have been found in this tissue, but most frequently the former. In these cases a cyst forms in the bone, which becomes thin and expanded, resembling the ordinary fluid cystic tumour, but

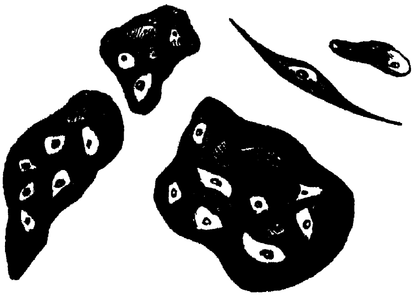


Fig. 424.—Myeloid Plates or Plate-like Cells from a Tumour of the Lower End of the Femur.

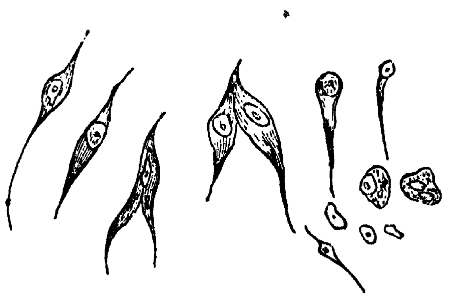


Fig. 425.—Fusiform and oat-shaped Cells from Myeloid Tumour.

which, on examination, is found to contain the entozoa. The *Treatment*, as Stanley observes, must depend on the situation and extent of the disease ; if it be a long bone that is affected, and it be much expanded, recourse must be had to amputation ; if it be a flat bone, the cavity must be scooped out, and dressed from the bottom with stimulating applications, so that it may fill with healthy granulations.

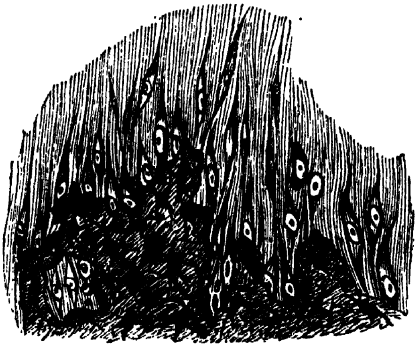


Fig. 426.--Spindle-celled Sarcoma Tumour springing from the Scapula.

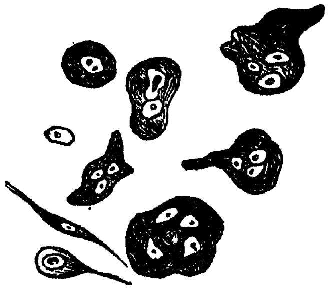


Fig. 427.—Microscopic Characters of the Tumour in its second Recurrence. Multinucleated Myeloid Cells.

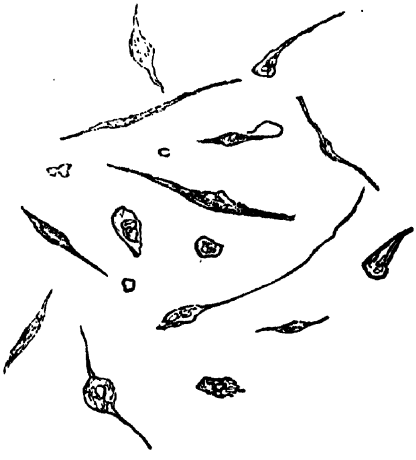


Fig. 428.--Cells from Spindle-celled Sarcoma Tumour of Scapula : First recurrence.

MALIGNANT DISEASE OF BONE.—Up to a very recent period, various tumours growing from the long bones and having certain common characteristics, such as extreme rapidity of growth, a tendency to pulpy degeneration, and to sprouting fungus, were looked upon as cases of cancer of bone, and were variously described under the terms of osteo-cancer, osteo-cephaloma, &c. More recent pathological observations have, however, thrown much doubt on the correctness of this view of the real nature of these very formidable tumours. And if the opinion be correct that true cancer can only be developed in connection with epithelial surfaces, we must discard the possibility of the existence of such a disease as primary cancer of bone. Virchow, indeed, refers most of the tumours that were formerly considered typical of this affection to the various classes of fibromata and sarcomata (Vol. I., p. 751). It would only be in such bones as the superior maxilla, and those generally in connection with the mucous membrane lining the cavities of the face, that true cancer could develop itself ; and even here the osseous tissue would only be involved secondarily, and not be attacked as the primary seat of the disease.

As these tumours of bone that have generally, though probably erroneously, been considered to be cancers, present many characters of malignancy, and as their true anatomical structure may in many cases still be somewhat uncertain, I shall in this chapter speak of them from their clinical rather than from a histological point of view ; and instead of attempting to arrange them into the various groups to which they pathologically belong, class them together under the one general broad designation of **Malignant Tumours of Bone.**

Two distinct forms of malignant tumour of bone are met with. In one form the morbid growth is *central,* springing from the medullary canal ; in the other it is *peripheral,* being only attached to the compact osseous substance.

In the *central* malignant disease of bone, the tumour is found to grow in the substance of, or to spring from, the interior of the medullary canal. It is usually situated at or about the articular ends, expanding the bone, which becomes completely enveloped and incorporated in the structure of the growth, either in the form of osseous rays diverging from the centre of the tumour, or more rarely as a thin shell of bone surrounding the mass, as in the more simple growths springing from this tissue. In either circumstance, it is important to bear in mind, this form of disease is never localised, but always invades the whole of the bone. The freedom of communication between the upper and lower ends of a long bone is so great, that, as has been shown by Richet, water injected at one end exudes in a few seconds at the other ; hence the juices of a malignant structure may easily traverse the whole length of the bone, and we accordingly find, on examining the osseous tissue at a distance from the tumour, that there are red patches in it here and there indicative of its infiltration with the morbid structure. These central malignant tumours of bone are in most cases sarcomata, or rapidly growing and soft enchondromata.

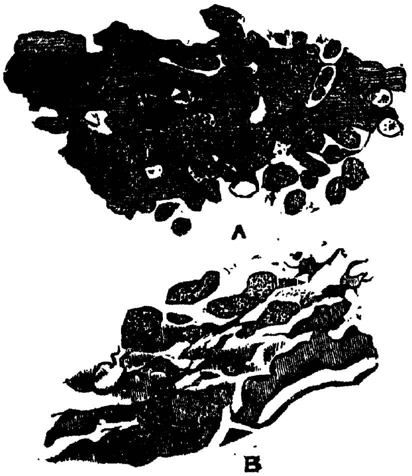


Fig. 429.—Calcified Nodule of Sarcoma of the Lung, secondary to a similar growth in a long Bone (188 diam.) A. Decalcified. The flat grey Surface represents the Calcified Stroma. B. Not decalcified. Shows the glistening bars of Calcified Stroma passing between the granular cells, which in some parts also are calcified.

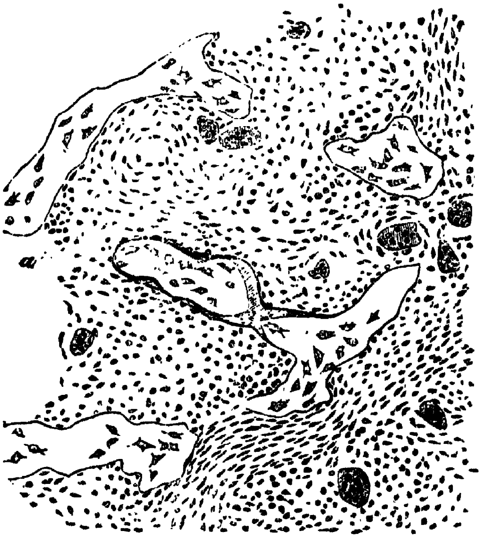


Fig. 430.—Myeloid Tumour of Lower Jaw (70 diam.), showing the manner in which the bone is invaded. a. The deep surface of the section.

Many of the malignant tumours of bone undergo calcification or ossification, and the same changes may be seen in the secondary deposits (Fig. 429). The method in which a tumour involves neighbouring healthy bone is illustrated in Fig. 430.

In the *peripheral* form of malignant disease of bone, which is probably the most common variety, the osseous tissue is not so completely invaded ; for, although the disease may be situated upon, or be in intimate contact with, the outer layers of the bone, which are incorporated in it, it does not extend into the cancellous tissue or the medullary canal. The tumour appears to spring from the periosteum; and, after removal and maceration, stalactitic projections and radiating fibres may be traced into it from the outer layers of the bone.

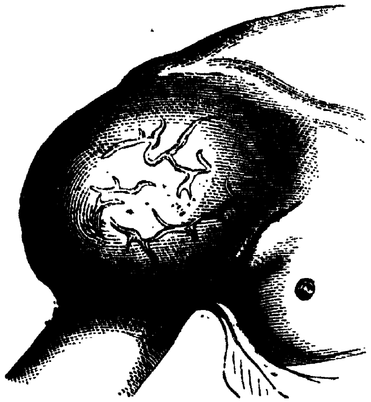


Fig. 431.—Rapidly growing malignant Tumour of the Head of the Humerus, with Spontaneous Fracture of the Shaft, in which I amputated successfully at the Shoulder-joint.

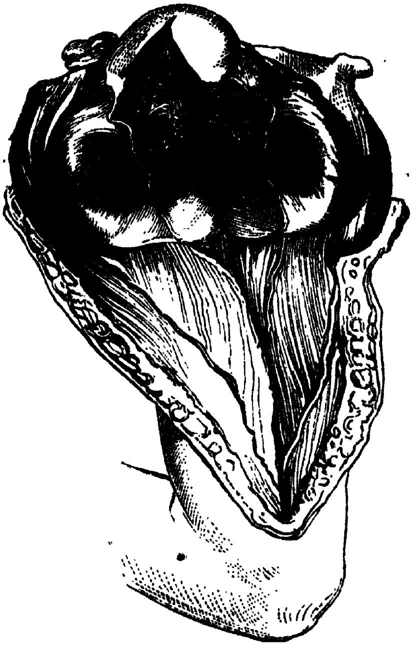


Fig. 432.—Section of rapidly growing malignant Tumour of Head of Humerus: upper end and Head of Humerus destroyed, but Cartilage of Incrustation unaffected. Tumour divided by white vertical lines—the Periosteum: inside which only were the Osseous Spicula found.

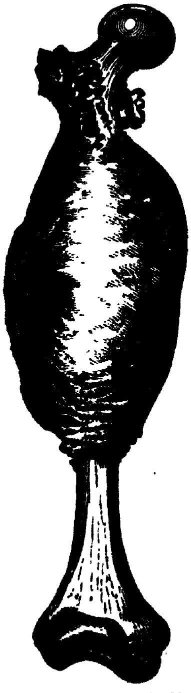


Fig. 433.—Spindle-celled Sarcoma of Shaft of Femur, successfully Amputated at Hip-Joint.

The tendency to the infiltration of neighbouring soft structures will vary greatly with the character of the malignant tumour. If a periosteal fibroma, it will remain encapsuled, and not implicate the structures in its vicinity. If a soft sarcoma, it may diffuse itself into areolar spaces and sheaths of muscles.

The accompanying cuts (Figs. 429, 430) illustrate the microscopical appearance presented by some forms of malignant tumour of bone.

*Situation.*—Malignant tumour of bone most frequently occurs in the head of the tibia and the lower end of the thigh-bone; occasionally in the humerus and in the jaws, more especially about the antrum. It is a remarkable fact, long ago pointed out by Petit, and more recently insisted on by Richet, and which I have often

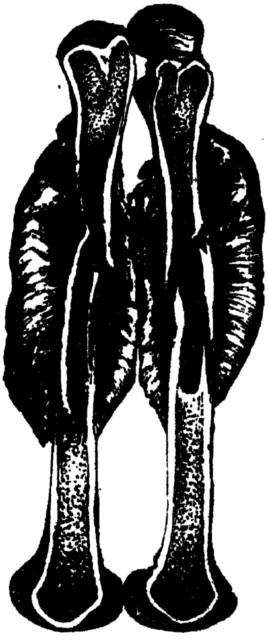


Fig. 434.—Spindle-celled Sarcoma of Shaft of Femur sawn open. Spontaneous Fracture.

had occasion to verify, that, although the epiphysis may have been completely degenerated, the cartilage of incrustation and of the neighbouring joint (Fig. 432) never becomes implicated; although the growth may eventually involve and include the whole of the rest of the articulation, by extension to the capsule and its soft parts. When internal organs become secondarily affected in these cases, the deposit will generally be found in the lungs.

*Symptoms.*—There is usually, with much lancinating pain, a rapidly growing enlargement of the bone, having a globular shape, feeling elastic, and sometimes semi-fluctuating. The skin covering it, at first pale, with numerous reticulated and blue tortuous veins, afterwards becomes discoloured, being eventually implicated in the morbid mass. In some cases fracture of the bone takes place at the affected part (Figs. 431, 433, 434); the neighbouring tissues are speedily contaminated, the lymphatic glands become enlarged, cancerous cachexy supervenes, and the patient eventually sinks. In other cases, the disease being central, the progress, especially in the early stages of the disease, is less rapid, though it at last developes itself with fearful violence. So long as the disease is confined within the walls of the bone, it developes itself but slowly, and does not show much disposition to affect the constitution. Some years ago I had under my care a man whose thigh I amputated for malignant disease of the head of the tibia; the disease had existed for four years, encapsuled, as it were, inside the head of the bone, without contaminating the neighbouring parts. The patient's constitution appeared sound, and he made a good recovery. But, when once the soft parts become engaged, the system is speedily contaminated. In some instances pulsation of a thrilling kind, with or without a blowing murmur, is distinctly perceptible, especially in an advanced stage of the affection, when the vascularity of the tumour is greatly increased.

*Diagnosis.*—The diagnosis of malignant disease has to be made from other tumours of bone, and from aneurism. The malignant growths of bone may readily be confounded with those various forms of *non-malignant disease* that are commonly included under the term *spina ventosa.* In making the diagnosis, we may reasonably come to the conclusion that the growth is malignant, if it occur in early life before puberty, or between this period and the early adult age; if it increase with great rapidity, and with much pain, especially of a lancinating character; if, to the touch, it present a somewhat diffused pulpiness, with much elasticity, great tension, and, at points, a semi-fluctuating feel; and more especially if the veins be greatly enlarged and tortuous, the neighbouring lymphatic glands involved, and if cachexy ultimately set in. These conditions, differing from the slow growth, the more circumscribed character, and more solid feel of the non-malignant tumours, which have no tendency to the implication of neighbouring structures, and which occur at later periods of life, usually enable us to make the diagnosis. There is one tumour, however, viz., *enchondroma,* which occasionally, in the rapidity of its growth, closely resembles malignant disease. Here the diagnosis is confessedly extremely difficult; though the more solid character, the less degree of elasticity, and the absence of lymphatic enlargement or implication of contiguous tissues, will often enable us to establish the true nature of a tumour before its removal.

The diagnosis from *aneurism* is necessarily unattended by any difficulty so long as its sac is pervious to fluid blood, and presents the characters that are met with in this condition. But if the sac have become consolidated by the deposit of stratified laminæ, and thus have assumed the characters of a solid tumour, it may readily enough be mistaken for a tumour springing from the osseous structure, and amputation has occasionally been performed on this supposition (as in Fig. 356). Pulsating osteo-cephaloma may be mistaken for *simple erectile tumour*, or for *aneurism by anastomosis*. In such cases, however, the history of the progress of the disease will do more to elucidate its true nature than anything else, attention being more especially paid to the early symptoms of the tumour, when the aneurism was still filled with blood.

*Treatment.*—No means are of any avail in cases of malignant disease of bone, except the removal of the diseased part by amputation or excision. These operations are, however, not very promising, as there are few forms of malignant tumour in which the disease returns more rapidly in a secondary manner than in that of the bones. The rapidity of recurrence will, however, greatly depend upon the form of the disease, or the time when *amputation* is performed, and on the part where it is practised. Amputation should always, if possible, be performed in the earliest stage of the disease, before glandular or constitutional infection has set in. If the glands be enlarged, and cachexy have already occurred, little can be expected in the way of ultimate cure : yet I have known cases in which, even in these unfavourable circumstances, the patients have made a good recovery, life having been prolonged for months. I believe that return is much more speedy and certain after amputation in the peripheral than in the central form of malignant disease of bone, provided that in the latter the whole of the bone has been removed ; this is due to the more extensive contamination of the soft parts in the former than in the latter case.

The selection of the line at which amputation should be performed is of great importance, and the result will materially depend upon the judgment displayed in this. If the limb be removed in the continuity of the diseased bone, there must necessarily be a great probability of a very rapid return of the morbid action in the stump ; and this probability amounts to a certainty in those cases in which the disease is central, and in which the whole of the medullary canal and cancellous structure are implicated, and infiltrated with cancer. In cases of peripheral disease, this return in the same bone may not take place ; indeed, I have seen one case of the kind in which the disease affected the lower end of the tibia, and that bone was amputated in its upper third ; in this case, after a lapse of some months, fatal recurrence of the disease took place in the pelvic bones, but not in the stump. As, however, the peripheral is more rare than the central form of the disease, and as there are no means of ascertaining the precise kind before removal, the rule, I think, should be definite to amputate at or above the next joint—at the hip-joint, in malignant disease of the femur ; in the thigh, for that of the bones of the leg ; and at the shoulder, when the upper arm is affected. When the lower part of the femur, however, is involved, amputation through the trochanters may sometimes be substituted for disarticulation at the hip-joint, the latter operation being so formidable and so fatal that the Surgeon may think it advisable not to subject the patient to so serious a risk; or amputation might be performed through the trochanters, and then the head of the bone extirpated from the acetabulum. In this way the severity of the operation and the extent of incised surface would be lessened, whilst the whole of the diseased bone would be removed.

In some forms of malignant bone-disease, however, the muscles inserted into the affected bone become speedily contaminated, and this contamination may spread widely through the substance or along the sheath of any particular muscle. Hence I think the rule in these cases should be to amputate not only above the diseased bone, but, if practicable, above the origins of the muscles in the neighbourhood of the disease: thus, if there be a malignant tumour of the bones of the forearm, amputation should be done not only above the elbow-joint, but above the humeral attachments of the muscles of the forearm.

The propriety of *excision* of some bones, as of those of the face, in this disease, must depend on whether the morbid deposit is limited to the structures that can be excised. This operation can rarely be advantageously practised in malignant tumours, there being in general too great an implication of the soft structures in the neighbourhood to justify it.

SANGUINEOUS TUMOURS are occasionally met with in bones. Stanley describes them as appearing under two forms:—1. As tumours composed of a vascular substance, having the general characters of erectile tissue, and bearing on section a close resemblance to certain nævi (Fig. 435); tumours of this kind may be removed without the liability to reproduction: 2. As cysts formed in the cancellous structure of a bone, and containing either fluid or coagulated blood. According to Stanley, these tumours expand the osseous walls, and gradually cause ulceration of the skin and profuse hæmorrhage.

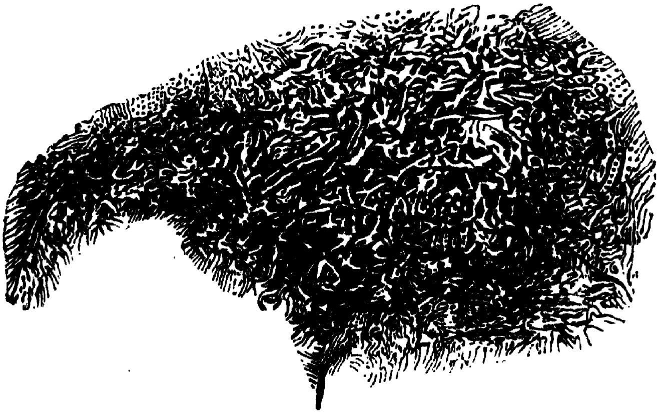


Fig. 435.—Aneurism by Anastomosis of one of the Parietal Bones.

The *Treatment* consists in the amputation of the limb, or the excision of the affected bone, as was successfully done by Travers, who removed a clavicle that was the seat of this disease.

OSTEO-ANEURISM.—*Pulsating Tumours of Bone*, or *Osteo-Aneurisms*, though of unfrequent occurrence, are of considerable importance to the practical Surgeon, on account of the difficulty that often exists in establishing a diagnosis between them and ordinary aneurisms. It is only of late years that this kind of disease has been fully recognised; and it is principally to the labours of Handyside, Nélaton, Stanley, and Roux that we owe an acquaintance with its characters.

*Characters.*—Tumours springing from bone, whether of a cartilaginous, fibrous, or cystic character, may have pulsation communicated to them from a neighbouring artery; but the true pulsating tumours of bone owe their pulsations to some inherent peculiarity of structure, which appears to consist either in the development of a vascular tissue of abnormal character, or else in the simple enlargement and dilatation of the vessels of the bone. In the former and more frequent class of cases, those in which a new tissue is developed in the osseous structure, we usually find the tumour to partake of the character of malignant growth; a creamy, curdy, or brain-like, soft, and very vascular mass is formed as an essential and principal constituent of it. This form of disease has been termed an **encephalo-osteo-aneurism.** This abnormal mass will be found to present every shade of transition, from true malignant growth to a purely vascular tissue of an erectile character. Billroth has described a somewhat similar condition as occurring in sarcomatous tumours of the bones of the lower extremity, in which numerous small aneurismal dilatations existed on the vessels, forming a network throughout the mass. In the second and rarer form of the disease, there is developed in the bone a structure, which originally, and in many cases throughout, is a **vascular erectile growth,** closely resembling capillary nævus in its structure, composed of an infinity of blood-vessels, interlacing in every possible way, so as to form a soft reddish-yellow tumour. In a third form, a hollow cavity is formed in the bone, scooped out of the cancellous structure and filled with blood, partly liquid and partly coagulated, and having arterial branches freely opening into it. The shell of bone surrounding this cavity is very thin and expanded, being usually absorbed at one point, where it often becomes at last perforated. This constitutes the **true aneurism of bone.**

*Situation.*—These various kinds of pulsatory tumour of bone have been met with in almost all parts of the body; most commonly the cancellous articular ends of the long bones, more particularly of the tibia, the radius, the humerus, and the femur, have been found affected. The pelvic bones are also not unfrequently the seats of these growths; and they have been encountered in the skull and the ribs.

*Symptoms.*—In its early symptoms an osteo-aneurism closely resembles the ordinary forms of spina ventosa, being oval in shape, uniform, and elastic to the touch, growing slowly, without enlargement of the veins or discoloration of the skin; these characters it possesses in common with most other tumours of bone. The special signs by which it is characterised, however, are its pulsation and bruit: the pulsation is very distinct, superficial, and commonly of a thrilling character; in other cases it is directly impulsive, and distinctly expansile; the bruit is most usually soft and blowing, but not unfrequently harsh, loud, and whizzing. In some cases the bruit is absent, though the pulsation continue distinct; this, according to Nélaton, is most frequently the case in true osteo-aneurism. In the pulsating malignant form of the disease, I have heard the bruit peculiarly loud, rough, and superficial. On compressing the main artery leading to the part of the limb in which the tumour is situated, all movement and bruit commonly cease in it, and the tumour lessens in size. By pressing upon the growth when it is thus diminished it will commonly be found to have a bony margin, with a central depression, more especially in those cases in which there is no malignant growth entering into its composition, the growth being apparently composed of erectile and expanded osseous tissue, filled with fluid blood. In some cases, however, the tumour is fed by several arterial branches, which may be felt distinctly pulsating under the skin. This is more particularly the case when it occurs upon the bones of the pelvis and the scapula, and then the bruit and pulsation cannot be made to cease in it. All these signs are commonly somewhat intermittent, appearing perhaps in the earlier stages of the disease, and disappearing as it advances; or the reverse may occur, the pulsation and bruit becoming distinct as the disease increases in size, and meets with more resistance in its outward growth.

*Diagnosis.*—It is of considerable importance in many cases to diagnose the different forms of pulsating tumour of bone from one another; some being of a truly malignant character, whilst others appear to consist of simple expansion of the vascular element of the bone, with atrophy of its osseous substance; and consequently the prognosis also in the two conditions is very different. The true osteo-aneurism has so many signs in common with the *pulsating malignant tumour* of bone, that in many cases it is almost impossible to effect the diagnosis; yet it is well to bear in mind that the malignant form of the disease is not unfrequently multiple, occurring, with pulsation and bruit, in more situations than one: thus I have seen growths of this kind, with their signs well marked, springing both from the pelvis and from the ribs. The true osteo-aneurism is met with only in the articular ends of long bones; whereas the malignant disease, though commonly occurring in these situations, is also frequently found in other parts of the body. Besides these, there are two conditions which, in many cases, will enable the Surgeon to determine that the pulsating tumour is an osseous aneurism: viz., the absence of all bruit, though the pulsation be distinct, and the detection by firm pressure, after the tumour has been diminished by compressing the artery leading to it, of an osseous margin around its depressed centre.

From *ordinary aneurism* the diagnosis of osteo-aneurism is, in many cases, attended by almost insuperable difficulties. So great are these, that there are many cases on record in which the most experienced Surgeons have ligatured arteries for tumours that were supposed to be aneurismal, but which have turned out to be pulsating growths connected with bone. A principal point to be attended to in effecting the diagnosis is the situation of the tumour, which may occur away from the ordinary sites of aneurism, in parts of the body where there is no vessel large enough to give rise to such a disease—as, for instance, about the head of the fibula or the side of the pelvis. Then, again, its incorporation with the subjacent bone, the want of a distinctly limited and circumscribed outline, and the existence in many cases of plates of bone in the wall of the tumour—giving rise perhaps, on pressure, to the peculiar rustling or crackling sound characteristic of expansive bony growths —will enable the Surgeon to come to a conclusion as to the true nature of the tumour. In this he will be further assisted by its giving on compression a soft, doughy, or spongy feel, or appearing as a depression surrounded by an osseous margin. In many cases also, the less impulsive character of the beat of the tumour, the peculiar shrill and tremulous whiz in the pulsation and bruit, will throw much light on the nature of the disease. But it cannot be doubted that, when tumours of this kind occur in some of the ordinary situations of aneurism, as about the brim of the pelvis, and in the popliteal space, the diagnosis is surrounded with difficulties which no amount of surgical skill or tact may be able to overcome.

From *ordinary tumours of bone*, the existence of pulsation and bruit will always suffice to distinguish the growths under consideration.

*Treatment.*—Incision into a pulsating tumour of bone, or any attempt to remove it without its osseous connections, is clearly contrary to the rules of good surgery; and when it has been practised, the hæmorrhage has been of the most alarming and dangerous character. *Resection* has been had recourse to in some instances, as when the disease has been seated on the cranial bones, but without success. Liston, in a tumour of this kind growing from the scapula, which he called "an ossified aneurismal tumour of the subscapular artery," excised the greater portion of the bone from which it sprang; but fungous growths reappeared in the wound, by which the patient was at last exhausted. When the disease has proceeded to such an extent as to produce extensive alteration in, and destruction of, the tissue of the bone affected, *amputation* of the limb is the only resource left to the Surgeon. This operation is also called for in those cases in which the disease returns after other means, such as the *ligature of the artery*, have been practised. In these cases, if the disease partake at all of the malignant character, the limb must be removed at a point above the affected bone.

The result of ligature of the main artery leading to the tumour depends greatly upon the nature of the growth. When it is partly composed of sarcomatous or other solid tissue, but little good can result from this proceeding—the tumour continuing to increase by an inherent growth, which will continue as long as the vitality of the limb is maintained; and we accordingly find that, in all such cases in which this operation has been practised, the progress of the tumour has either not been retarded, or, if the pulsations have been stopped and its size lessened for a time, the activity of the symptoms has speedily returned, and amputation has been rendered necessary. When, however, the tumour has partaken more of the characters of true osteo-aneurism, then a more favourable result has followed the ligature of the main artery of the limb. In a case of this kind seated in the radius, in which Roux ligatured the brachial artery, a complete cure resulted. The same also occurred to Lallemand; and in a patient of Dupuytren's there was no return of the disease for six years, when it recurred, and amputation became necessary. These results are sufficiently satisfactory to justify the Surgeon in having recourse to the ligature, or perhaps the compression, of the main artery of the limb, in those cases in which the tumour can be ascertained not to partake of the nature of malignant growth.

# CHAPTER XLVIII.

## DISEASES OF JOINTS.

The various joints of the body may become the seat of Inflammatory Affections of an acute or chronic character; of Strumous Disease; or of various other morbid conditions, such as more or less permanent rigidity, or Ankylosis, the formation of Foreign Bodies within their cavities, or their Malignant Degeneration, and Neuralgia. In studying these various articular affections, it must be borne in mind that a joint is composed of a number of different tissues; of synovial membrane, cartilage, ligament, bone, and capsule, or investing fibrous expansion. In any one of these structures the disease may primarily begin, though eventually the morbid action often spreads to other tissues besides that which was originally involved. The merit of having been the first to point out the true mode of studying these affections in reference to the different structures in which they have originated, and to have set aside that coarse pathology which, under the general terms of "arthritis" and of "white swelling," confounded together these various diseases, is certainly due to Sir Benjamin Brodie.

### SYNOVITIS.

**Inflammation of the Synovial Membrane**, the most common perhaps of all the articular affections, may be acute, subacute, or chronic.

Causes.—Whatever form it assumes, synovitis usually results from exposure to cold, especially in rheumatic or syphilitic constitutions. In these cases it commonly happens that more joints than one are implicated at the same time; and the affected articulations are more frequently those that are most exposed by having the thinnest covering of soft parts, and by being especially subjected to transitions of temperature, such as the knees and ankles. Injuries of joints, as blows, bruises, wounds, or sprains, will also frequently occasion this inflammation; but when arising from such causes, it is usually associated with inflammation of the other textures of the articulation.

Pathology.—As uncomplicated acute synovitis is never fatal, we seldom have an opportunity of studying its pathology. It would, however, appear from the examination of joints in cases of synovitis from injury, as well as from the experiments of Richet, Bonnet, and others, who have induced traumatic synovitis in animals, that there is in the first instance an inflammatory congestion and vascularity of the membrane, with loss of its peculiar satiny polish. The synovia is then increased in quantity, and becomes thin and serous, and after a time intermixed with plastic matters which are poured out with it. If the disease progress favourably, these products are more or less completely absorbed. In more rare cases, the vascularity and swelling of the synovial membrane increase, until at last it becomes so turgid and distended with blood and effused fluids, that a kind of chemosis results; a thin purulent-looking fluid, composed of granular corpuscles, floating in a serous liquid, is poured out, and disintegration, with thinning and erosion of the cartilage, and probably complete destruction of the joint, ensues. In other cases, granulations are thrown out on the looser portions of the membrane, and becoming injected with blood-vessels, constitute fringed and villous membraneous expansions, lying upon the subjacent disintegrated and eroded cartilage.

SYMPTOMS.—**Acute Synovitis.**—The symptoms of synovitis consist of pain and heat of the joint, with distension and fluctuation of it. If it be large and exposed, the *pain* is severe, especially at night, being greatly increased by moving or pressing upon the articulation; it is usually sharp, but when the disease occurs in rheumatic or gouty constitutions, of a gnawing character. In purulent synovitis from pyæmia, it is usually very superficial, indeed almost cutaneous. On laying the hand on the joint, this will be felt to be *hot*.

The *swelling* of the affected joint is considerable, and evidently depends on accumulation of fluid within the synovial sac, the extreme outline of which is rendered apparent by the tension to which it is subjected. Thus in the knee it rises up high in the thigh under the tendon of the quadriceps extensor, to the extent of three or four inches above the upper border of the patella, the swelling being higher on the inner than the outer side of the limb, whilst in the elbow it rises in the same manner under the tendon of the triceps. There is but little if any effusion into the surrounding tissues; and hence the outline of the joint can be distinctly felt, and *undulation* perceived in it. The limb is usually semiflexed, as giving the patient most ease, and the joint cannot be moved. The constitutional febrile disturbance is tolerably severe, especially if the affection occur in a rheumatic constitution.

**Chronic Synovitis.**—The disease, at first acute, may terminate in a subacute or chronic form; or, subacute at its commencement, it may fall into a chronic condition. Chronic synovitis is characterised by all the symptoms of the acute variety of the disease, but in a less severe degree. The swelling and weakness of the joint are the most conspicuous local conditions. In some cases, the swelling from accumulated serous fluid is so considerable as to constitute a true dropsy of the joint—**Hydrarthrosis.** This accumulation of fluid, partaking in various degrees of the characters of serum and synóvia, is usually preceded or accompanied by evidence of synovial inflammation; but, though this generally happens, it is not invariably the case. Richet, in particular, has recorded instances from which it would appear that inflammation is not a necessary or invariable accompaniment of the affection, the synovial membrane being indeed preternaturally white, and looking as if it had been washed or soddened; and though these cases are rare, those that commonly present themselves to the Surgeon being of a decidedly inflammatory character, yet their occasional occurrence is sufficient to establish the existence of a passive, as well as of an inflammatory form of the disease.

The presence of an abnormal quantity of fluid in the joint is always readily perceived by its *fluctuation* and *undulation* and by the *peculiar shape* that it cure without ankylosis ; a new and healthy action having been imprinted on the synovial membrane. This mode of treatment does not appear hitherto to have met with much support in this country ; yet it certainly deserves a trial, though recourse should not lightly be had to it, as it is evident that the induced inflammation might exceed the expected limits. In one case of hydrarthrosis of the knee, in an old man, in which I employed it, about six ounces of thin synovia were drawn off, and a drachm of strong tincture of iodine was injected into the joint. Slight inflammation only ensued ; and the disease, which was of two years' standing, was completely cured. The chief points that appear to require attention are that no inflammation be going on at the time, there being no tenderness or pain in moving the joint, the effusion being quite passive, and of a very chronic character ; and, above all, that no air be allowed to enter with the injected fluid. After dropsy of the joint has been removed, the articulation is usually left weak for some length of time, in consequence of the stretching to which its ligaments have been subjected : here cold douches and an elastic bandage will constitute the best mode of treatment.

## ARTHRITIS.

SIMPLE, ACUTE, AND CHRONIC ARTHRITIS.—By **Arthritis**, in its simple form, is meant inflammatory disease of an acute or chronic kind of the whole or greater part of the structures that enter into the formation of a joint. This affection may commence in the *synovial membranes*, and then spread to the other articular tissues ; or it may begin in the *cartilages* or *bones*.

Diseased action is very seldom primarily set up in the *ligaments* of the joint ; though these structures commonly become elongated, softened, and destroyed, as a consequence of other forms of articular disease. But, though primary inflammation of the ligaments is so rare an affection as to have been denied by many, yet it certainly does occasionally occur. This is especially seen in the hip-joint, where the inflammatory affection may commence in the round ligament ; illustrative of which there is a very beautiful model in the University College Museum.

Inflammation may commence in the *fibrous capsule* of the joint : this we find more particularly to be the case when the affection is of a rheumatic character ; in these cases inflammation, running into suppuration and slough of this structure, will commonly spread to the internal parts. In some instances this form of disease gives rise to the deposition of masses and layers of bone in the areolar structures outside the articulation.

*Causes.*—In some instances, *acute necrosis of the shaft* of one of the long bones, as of the tibia, will extend to the epiphysis, and thus run on to destructive action in the terminal articulations, the cartilages becoming undermined, softened, and perforated. It not unfrequently happens that the arthritic disease is a result of a *morbid condition of the articular ends* of the long bones, or of those short bones that enter into the formation of the joint ; this we especially see in diseases of the foot, of the elbow, of the knee, and hip ; but it is a condition which, I believe, may occur in any joint. The bones usually become, in the first instance, the seat of tuberculous infiltration ; this runs into unhealthy suppuration, which gives rise to caries and limited necrosis

(Fig. 436 *a*); as the diseased action approaches the articular surface, the incrusting cartilage becomes loosened and detached, and at the same time gradually disintegrates, and becomes perforated (Fig. 436 *b*), nutrition in it being arrested or modified by the morbid state of the subjacent bone. When once the cartilage becomes affected, the whole of the interior of the joint speedily suppurates, and is destroyed. In other cases, inflammatory congestion, but without the formation of tuberculous matter, takes place in the articular ends, which become somewhat expanded ; and then, without any suppuration occurring in the osseous structure, the cartilage gradually separates or peels off, and becomes softened and necrosed. This condition is often met with in disease of the tarsal articulations.

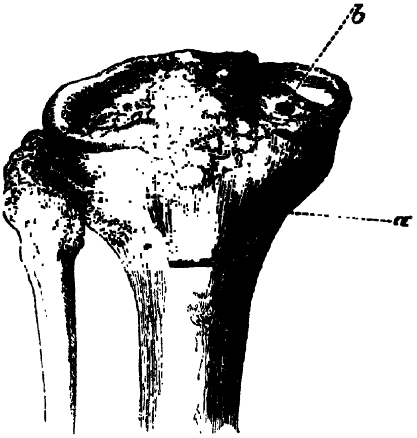


Fig. 436.—*a*, Caries of Head of Tibia: *b*, Perforation of Cartilage.

Arthritis commonly results from *wounds of joints* or *injuries*, such as sprains and fractures occurring in their vicinity, more particularly in young people and in those of a lymphatic constitution. It also occurs as a not unfrequent accompaniment of *pyæmia* (Vol. I. pp. 716, 727), and of some of the morbid conditions of the *puerperal state*. The puerperal inflammation of joints is of a very destructive character, most generally speedily terminating in suppurative disorganisation. One or several joints may be affected, and the knee is the one that is most frequently and seriously involved. Puerperal arthritis probably depends upon a purulent infection of the blood, the result of uterine phlebitis. Arthritis not unfrequently occurs as a consequence of *scarlatina;* the knee-joint is often affected in a destructive manner after this disease. In some forms of *albuminuria* there is also a great tendency to inflammation of the joints ; and, indeed, I have so frequently seen that form of renal dropsy which follows scarlet fever accompanied by serious, sometimes destructive, inflammation of some joint, as almost to look upon one condition as the sequence of the other.

Acute Arthritis of a single large joint is never rheumatic. In rheumatism more joints than one are always affected. Where one single joint, such as the knee, is attacked by disorganising inflammation, the disease arises from one of three diseases, viz., struma, pyæmia, or gonorrhœa. When strumous, it will usually partake of the character of white swelling, or commence in the osseous articular ends. When commencing in the synovial membrane and confined to the soft articular structures, it will be found (when not traumatic) to be either pyæmic—possibly in women puerperal—or gonorrhœal. In either case the prognosis is bad—in the first to life, in the last to the joint.

In old people, acute disorganising arthritis is occasionally set up without any injury or other external exciting cause. I have in this way seen the joints of the foot, the ankle, and the sterno-clavicular articulation rapidly destroyed, with great local inflammatory excitement and severe constitutional disturbance of a low form. These attacks are often mistaken in the first instance for gout; but the rapidity of the disorganising action, the formation of pus within and around the joint, the necrosis of the contiguous bones, and the separation of the incrusting cartilages, all indicate the different nature of this affection; which, so far as the joint itself is concerned, is incurable, and which may terminate in the loss of the patient's life.

*Symptoms.*—The symptoms of arthritis that are most marked are the pain, heat, swelling, and peculiar position of the joint. The *pain* is often severe, tensive, and throbbing: so acute is it sometimes, that the patient screams with agony; he cannot bear the bed to be touched, the room to be shaken, or the slightest movement communicated to the limb, any attempt at examination of joint in such cases being attended with insupportable agony. There are usually nocturnal exacerbations, and the pain is commonly referred with especial severity to one particular spot in the joint; thus it is generally felt at the inner or under side of the knee-joint, and at the outer aspect of the hip. The *heat* of the diseased joint is considerable, and is often accompanied with more or less superficial redness. The *swelling* is uniform, involving the whole of the articulation, and not projecting at certain parts of it, as when the synovial membrane alone is affected; it is generally not very considerable, and has a soft and doughy, rather than a fluctuating feel. As the disease advances, however, the swelling generally increases suddenly, and to a considerable extent, either in consequence of the irritation of the synovial membrane, or of the accumulation of pus within or around the joint. In many cases the synovial membrane gives way, and the pus from the interior of the joint becomes widely diffused through the muscular interspaces of the limb, forming enormous abscesses and long sinuous tracts. The *position* of the affected limb is peculiar, and that attitude is insensibly adopted in which the patient will have the greatest amount of ease; thus the knee is semiflexed and turned outwards, the thigh is abducted, and the elbow is bent. *Spasms* or *startings* of the limb, often of a very sharp and painful character, come on at times; more particularly at night. Amongst the most distressing symptoms in the more advanced stages of acute disorganisation of a joint are the painful startings of the limb whenever the patient falls to sleep. The muscles becoming relaxed the softened articular structures allow the joint to become slightly displaced; a reflex contraction of the muscles immediately takes place and the patient wakes with a painful spasmodic jerk of the limb, inducing a feeling of alarm, that is often very distressing. The *constitutional disturbance* is very severe, and of an actively febrile type.

As the disease progresses, *suppuration* takes place within the joint, which becomes hot and red, with a good deal of throbbing pain, and at last fluctuation is perceived where the coverings are thinned. In some cases the suppuration occurs with very great rapidity, and luxation of the head of the bone takes place. In other cases the synovial membrane and capsule of the joint give way without any looseness of ligaments or displacement of bones, pus becomes infiltrated into the areolar tissue around the joint, an abscess forms externally to the articulation, and extensive purulent collections become diffused through the limb. As the joint becomes loosened by the destruction of its ligaments, the bones become mobile, and grate against one another where the incrusting cartilage has been removed, thus giving rise to very severe suffering. The cartilages may, however, in some cases be very extensively destroyed, and yet no grating take place; this is owing either to the destructive action being limited to the edge of the encrusting cartilage, the opposed surfaces being sound, or else to the interior of the articulation being filled up with plastic matter after the removal of the cartilages. But though abscess, either within the joint or external to it, usually forms when the bones grate and the cartilage disintegrates, yet it occasionally happens that these conditions take place—those symptoms that are indicative of the erosion of the cartilage, such as painful startings of the limb, grating, and preternatural mobility of the joint—and yet no abscess forms; all the symptoms subsiding under proper treatment, and the joint recovering, though perhaps with a certain degree of ankylosis. But the reverse may also take place. Suppuration may take place in a joint, either as the result of pyæmia or of injury, the synovial membrane and the capsule may give way, extensive infiltration of pus into the deep areolar planes of the limb may occur, and yet no laxity of ligament, no preternatural mobility of the bones, no grating of the osseous surface, indicate the disorganisation of the articulation which is in progress. This condition may occur in any joint; I have most frequently met with it in the knee. There the upper and usually the outer part of the capsule generally gives way, and the pus diffuses itself deeply through the muscles of the limb, sometimes between the periosteum and the bone even. In these cases the thigh swells greatly, the limb becomes œdematous, and a deep and obscure sensation of fluctuation may perhaps be felt, more especially towards the outer and lower part of the limb just above the knee. The swelling of the joint has perhaps subsided, giving a false idea of security, which is confirmed by the absence of signs indicative of disorganisation, such as lateral mobility and grating. But on pressing the thigh downwards, the joint will be found to fill, the patella will float again, and there is an evident communication between the interior of the synovial membrane and the extensive diffused abscess in the thigh. In cases of this kind the pus will first come to the surface about two or three inches above and to the outer side of the joint; and, on a free incision being made here, immense quantities may be let out. In these cases the fluctuation is often masked by the œdema of the limb, and by the thickness of the overlying mass of areolar tissue and muscle, and will require the closest examination and the most practised finger for its detection. After suppuration has taken place, the constitutional disturbance partakes of the irritative type, the patient suffering severe pain, and being worn out by want of rest. Hectic may occur, and death from exhaustion and irritation, unless the diseased part be removed. In other and less severe cases it falls into a state of chronic thickening, perhaps with fistulous openings leading down to the diseased structures; and in some of the more favourable instances the patient may recover, with a permanently rigid joint.

There is occasionally, but very rarely met with, a form of acute arthritis occurring independently of any external cause, but dependent on disorganisation of the cartilages, apparently from simple loss of vitality, in old persons of feeble constitution. It resembles in this respect that form of senile necrosis of bones described at p. 177. In the senile arthritis now alluded to the pain is very acute, the enlargement of the joints considerable, the wasting of muscle rapid and great. The constitutional disturbance is proportionately severe. The joint that it most frequently affects is the knee. I have also seen it in the wrist. This form of arthritis must not be confounded with the dry rheumatic arthritis of old people. It differs from this form of the disease in the acuteness of its local symptoms, and the severity of the constitutional disturbance.

On examining the joint after removal, the cartilages will be found to be ulcerated, the synovial membrane softened, swollen, and injected ; the ligaments softened, and the articular osseous ends vascular.

The *Treatment* must be conducted on the ordinary principles of rest, fomentations, opiates, and supports. But at last, in order to save destruction of life by pain and exhaustion, the question of amputation will arise, and serious as this may be in old people, it will be the only alternative and chance of escape from a painful death.

*Diagnosis.*—*Abscess* may form externally to, but close upon, the capsule of a joint, and closely simulate disease of the articulation. In these cases the absence of serious constitutional disturbance, the irregularity of the swelling, greater on one side than the other, its extension over bony points, as the patella or olecranon, the superficial character of the fluctuation, the absence of all rigidity about the joint or of that preternatural mobility in a horizontal direction which arises from softening of the ligaments, and of other severe local symptoms, such as pain, starting, looseness, or grating, will enable the Surgeon to effect a correct diagnosis.

*Pathology.*—In arthritis, the principal changes are undoubtedly found to take place in the cartilages ; at the same time, it must not be supposed that all morbid appearances that are found in these structures are the result of inflammation, as erosion and absorption of their tissue may take place independently of any inflammatory action. The long-continued disuse of a joint, as in the treatment of fractures, may occasion this ; and in old people it is very common to meet with a porcellanous or ivory-like deposit on the articular ends of the bones, which, however, does not prevent the joints from being used, though it may occasion stiffness and pain in them. According to Quekett, this porcellanous deposit is of two kinds ; one consisting of unorganised earthy matter, the other of true bone having the Haversian canals filled with phosphate of lime.

In *acute* arthritis, the cartilages are usually found ulcerated and eroded in patches of varying size, exposing bone, which is rough and vascular. The remains of the cartilage are softened, inelastic, opaque, and thickened, and separate easily from the subjacent bone, which can be felt rough and grating. The synovial membrane is usually much thickened and very vascular ; the vascularity being most distinct about those parts where the erosions and grooves in the cartilages are deepest, and often assuming a dentated or fringed appearance. In other parts, especially about the circumference of the joint, smooth and semi-transparent masses of plastic matter, having a somewhat fatty look, are deposited underneath and upon the synovial membrane ; the ligaments are relaxed, vascular, and softened, and the interior of the joint is filled with thin, flaky, and light-coloured pus. The capsule and the cellular tissue around are thickened, and either infiltrated with pus or clogged with the same kind of plastic matter that is seen in the interior of the joint. The articular end of the bone is enlarged, soft, and vascular; and in strumous cases may be the seat of tuberculous infiltration (Fig. 436).

**Nature of the Changes in Cartilage.**—The changes that take place in the cartilage in this disease have excited much attention amongst Surgeons, and a good deal of difference of opinion exists as to the mode in which they are induced. Many Surgeons hold the doctrine that, cartilage being extravascular, the changes that take place in it are accomplished through the medium of the contiguous synovial membrane or bone, and consequently are secondary to disease of these tissues. We may, I think, conclude that this disease of cartilage may arise in three ways: 1, through the medium of the Synovial Membrane; 2, through the medium of the subjacent Bone; and, 3, by means of changes taking place in the Cartilage itself.

1. The destruction of cartilage, as the result of *Synovial Disease*, may best be studied in cases of wound of a joint. In these cases it will be found, if the joint be examined before complete disorganisation of it has occurred, that the diseased action spreads from the free surface, where it is most intense, downwards into the substance of the cartilage, which, superficially diseased, appears more healthy the deeper the examination of it is carried. Immediately under the swollen, gelatinous-looking, brightly injected synovial membrane, the cartilage will be found to be reddened, roughened, and softened. On examining a thin slice of this, it will be found to be composed of granular matter and nuclei of cells whose walls have disappeared. At a little greater depth than this it will present an opaque matrix, with cells, some perfect, others imperfect or disintegrating; and below this level we come to healthy white cartilage, with clear matrix, and well-formed cells. The disorganisation of the cartilage will eventually go on to its complete removal, and to the exposure of bare and roughened bone. It is in this way that destruction of joints, as the result of punctured wounds, pyæmia, or puerperal inflammation, results.

Aston Key advocated the doctrine that a peculiar disease was set up in the synovial membrane, so as to form a fimbriated or fringed vascular network or tissue, by means of which the cartilage was absorbed; and that, as this membrane extended, so did the removal of the cartilage go on. That an appearance of this kind in inflamed joints is of common occurrence, is doubtless true; but Goodsir has attempted to prove that Key erred in attributing the disintegration of the cartilage to this membrane; he states that a fibrous tissue forms in a diseased joint as the result of the disintegration of the cartilage, and that this, which is connected with either the synovial or the osseous surfaces, speedily becomes vascular. So far, therefore, from being the organ by which the cartilage is removed, it is the result of prior disease in this structure. At the same time it cannot be doubted, that an injected villous state of the synovial membrane does modify the nutrition of the subjacent cartilage in such a way that disintegration, erosion, and apparent ulceration of it will ensue; and this view is strongly supported by the researches of Billroth.

2. Disease of cartilage primarily dependent on *Morbid Action in the Subjacent Bone* is, I believe, one of the most frequent modes of disorganisation of joints in strumous subjects, and most certainly leads to those rapidly destructive

affections of joints, in which amputation or excision is required. In these cases, either as the result of violence, or from constitutional causes, the articular ends of a bone, or the whole of a bone if it be one of the tarsal, becomes congested, inflamed, carious, or necrosed, sometimes infiltrated with cheesy matter. In consequence of this disorganisation of the osseous tissues, the incrusting cartilage becomes detached, its under or attached surface softened, and at last perforation takes place, as in a preceding cut (Fig. 436 *b*, p. 217), taken from the tibia of a boy whose limb I amputated for acute disorganisation of the knee-joint, following carious disease of the head of the tibia. This process of disintegration, and at last perforation and erosion of the cartilage, takes place in a direction from below upwards. So soon as perforation occurs, the whole of the interior of the joint becomes acutely inflamed, and suppuration is set up in it, the ligaments loosen, and complete disorganisation ensues (Fig. 437). On examining the diseased patch or cartilage in cases of this kind, it will be found to correspond to the carious or tuberculous bone, from which it is separated by some bloody fluid; it will also be seen that the under edges of the erosion or perforation in the cartilages are separated to some extent from the subjacent bone, from which they readily peel off, and that they are bevelled off towards the aperture.

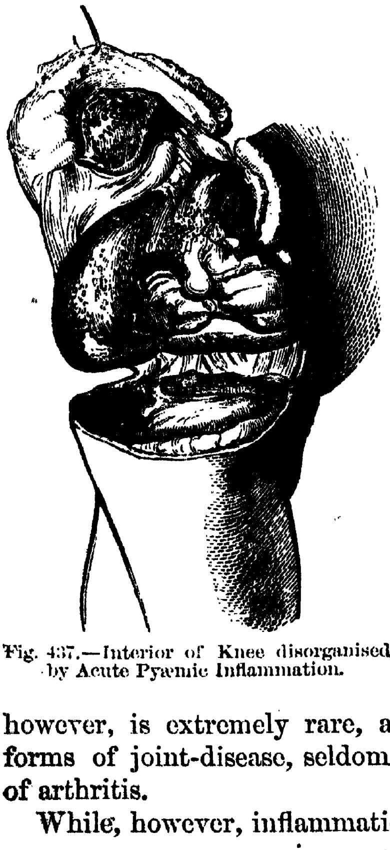


Fig. 437.—Interior of Knee disorganised by Acute Pyæmic Inflammation.

3. That cartilage is susceptible of *Primary Change of the Nature of Inflammation or Ulceration*, induced by the action of its own vessels, was the opinion of Brodie, Mayo, and Liston, all of whom had observed true vascularisation of cartilage. This condition, however, is extremely rare, and is certainly not one of the more common forms of joint-disease, seldom occurring except in the more chronic stages of arthritis.

While, however, inflammation, as the term is commonly understood, is of rare occurrence as a primary change in a cartilage, certain of the accessory or constituent conditions of the process are liable to be met within this tissue. The observations of Goodsir, of Rainey, and of Redfern, all point to the fact that cartilage, like other extravascular tissues, is subject to transformations, independent of the prolongation of vessels into it. The changes that ensue are, according to Redfern, of the following kind. The cartilage-cells enlarge, become rounded, and granular-looking; and, instead of their containing two or three nuclei, a considerable number are enclosed in the cell-wall; eventually these corpuscles break up, and are disintegrated. The matrix of the cartilage now softens, and, according to Redfern, splits up into fibres or bands which become nucleated. A species of fatty degeneration also, as pointed out by Rainey, takes place, and helps to soften and break down the structure of the cartilage. In the more advanced stages of disease of cartilage, masses of porcellanous deposit are found attached to the ends of the bones in plates and layers, taking the place of the eroded cartilage.

In other cases, a soft, pulpy, and vascular fibro-plastic deposit of a greyish-ashy or reddish-brown colour, with whitish streaks of a firmer material running through it in various directions, takes the place of the cartilage that has been removed, or that has undergone fibro-cellular degeneration. On examination under the microscope, this will be found to be composed of plastic material, with cartilage-corpuscles intermixed, and with the subjacent bone in a state of disintegration and softening. This condition of joints I believe to be analogous to the "pulpy degeneration of the synovial membrane" of Brodie. It would appear, from the microscopical examinations that I have in various cases made of this material, to which my attention was first directed by Quain, as occurring in a patient of his whose elbow-joint I excised, that it is either fibro-cellular degeneration of the cartilage, or an imperfect attempt at repair set up in the articulation, after the removal of the cartilage by previous disintegration and disease. On making a vertical section of the surface of the diseased articulation in the case alluded to, it was found that the pulpy and villous substance covered the bone to the thickness of a line and more in some parts. The bone was found to have its cells filled with oil-globules, but surrounded by tolerably healthy osseous tissue, showing the usual laminæ and bone-corpuscles. Nearer the diseased surface the laminæ and corpuscles became less distinct ; and, still nearer, the cells of the bony tissue appeared to be surrounded merely by a layer of fibrous texture, in which irregular particles of bone were observed. These particles, which were elongated, irregular in form, and rounded off at the angles, were very aptly compared by Dr. Quain to crystals in a state of solution. At the diseased surface, the place of the cartilage and synovial membrane was occupied by a fibrous texture abounding in cells, larger than pus-cells, nucleated and spherical, containing numerous granular particles. Irregular masses of cartilage, undergoing the same process of softening as the bony particles already mentioned, appeared in this fibrous texture. The morbid appearances found in this case were so characteristic that they may be taken as the type of this peculiar morbid condition, which I have since repeatedly met with in other articulations besides the elbow, more particularly those of the fingers and the knee, and which always, I believe, constitutes an incurable form of disease. I have met with this condition in instances only in which the articular affection has been of very old standing, and has fallen into a truly chronic state.

**Repair.**—When repair takes place in a joint, the cartilages of which have been eroded or destroyed, it is by the articular ends of the bones becoming connected, and the surface from which the cartilage has been removed filled up by fibro-cellular tissue, forming a kind of cicatricial material that leaves the joint permanently stiffened. In other cases porcellanous deposit takes the place of the eroded cartilage ; and, in some instances, the exposed osseous surfaces may grow or become soldered together, forming a permanently ankylosed and immovable state of the articulation. In no circumstances does cartilage, when once destroyed, become regenerated.

The *muscles* in the neighbourhood of an inflamed joint undergo a species of acute atrophy. The wasting and the flaccidity are both more than can be accounted for by simple disuse. The muscles chiefly affected are those above the joint; the gluteals in coxalgia—those of the thigh in inflamed knee—those of the arm in affections of the elbow-joint. This acute atrophy of muscle occurs equally in cases of arthritis that are non-suppurative, as in those in which pus is formed. It would appear as if the local afflux of blood was diverted towards the inflamed joint and the articular structures outside it, and that thus the nutrition of the capsular and neighbouring muscles was impaired.

*Treatment.*—In the treatment of *acute* arthritis, perfect rest of the articulation is of the first moment. Unless this be secured, no other treatment can be of any avail. The limb should be comfortably supported on pillows, or laid upon a well-made and softly padded leather splint, or slung in a cradle. But not only is rest, amounting to absolute immovability of the joint, imperatively required as the first means of cure, but there is a second means which is almost of equal importance, with the view of removing pain, and preventing destructive disorganisation of the articulation and consequent ankylosis,—I mean slight extension of the limb, so as to separate the articular surfaces very slightly from one another, and to prevent the excessive and agonising pain, that results partly from the pressure of one inflamed articular surface against the other, by the semi-contraction of the muscles of the limb, partly from the spasms that shake the limb and body from time to time, when the patient falls to sleep. These pains are not relieved entirely by simple rest and pressure—more especially that pain which results from the spasmodic action of the muscles of the limb: but they are usually at once removed by extension, by means of a weight attached to the lower part of the limb. This is particularly the case in inflammations of the hip and knee joints. It is in these cases that the weight-extending apparatus, combined with perfect rest, is so advantageous. The weight should be proportioned to the age of the patient. Its use will often at once relieve pain, and enable the sufferer to procure sleep. Fomentations and usual topical soothing treatment may be combined with these means. In the acute stage of the disease, the internal remedy from which the most essential service may be derived is the calomel and opium pill (gr. ij. and gr. ½) every fourth or sixth hour, at the same time that a strict antiphlogistic régimen is persevered in. After the violence of the symptoms has been subdued, and the disease has assumed a *chronic subacute* form, some modification must be made in the treatment. In this stage *rest*, absolute and immovable, is equally imperative as in the acute stage. It may be secured in the same way. But in many cases I know no more efficient method of steadying the inflamed joint than the application of the starched bandage, the limb having been previously enveloped in a thick layer of soft wadding. The joint may be repeatedly blistered; but in many instances most benefit will be derived from the application of the actual cautery. This agent, when properly applied, yields much more certain and successful results than any other form of counter-irritation with which I am acquainted. The patient having been anæsthetised, a cauterising iron, heated to a black-red heat, should be rapidly drawn over the diseased articulation in a series of parallel lines, across which an equal number of cross-bars are again drawn, so as to char, but not destroy the true skin. A good deal of inflammatory action is thus set up, followed by slight suppuration. When this has subsided, the application of the hot iron may, if necessary, be repeated; in this way the deep gnawing pain will usually be readily removed, and suppuration of the joint may be averted. For counter-irritants to be of any use, they must be employed before suppuration has set in; I believe that it is only torturing the patient unnecessarily to have recourse to these agents when once pus has formed in the articulation. In order that full benefit should be derived from this plan of treatment, it must be persevered in steadily for a considerable length of time, and should be conjoined with a moderately antiphlogistic and alterative treatment. With this view, the perchloride of mercury, in doses of from one-sixteenth to one-twelfth of a grain, may be advantageously given with the compound decoction of sarsaparilla, or, if there be much debility, with the compound tincture of bark; good food and stimulants being conjoined with it, in proportion to the advance of the debility. In proportion as the inflammatory action about the joint subsides, a tonic plan of treatment on ordinary medical principles should be substituted for that which had previously been employed.

With respect to the local treatment of the inflamed joint in the *more advanced forms* of the disease, it may be stated generally that, so long as it is tender on pressure, applied perpendicularly or laterally, so long as there is any loosening of the ligaments, or pain induced by movement, it must be kept absolutely at rest in splints, or what is better, by a starched bandage well wadded. During this period great care must be taken to keep the joint in a position most useful to the patient in after-life in the event of ankylosis taking place. But every means consistent with the safety of the joint should be taken to prevent its becoming stiff. With this view, as the inflammation lessens, and when pain has subsided, friction, douches, and passive motion should be employed; and if it be in the lower limb, slight extension by means of a weight attached to the foot may be kept up, so as to separate the articular surfaces from one another, and thus to lessen the chance of ankylosis by plastic bands. Should, unfortunately, these means fail, and suppuration take place in the joint, active steps must at once be taken to let out the pus freely and completely. If the skin covering it be reddened at any one part, the abscess should be freely opened by one or two lateral incisions, extending fairly into the joint, so as to afford a free exit for the pus. In some cases, even when abscess has formed, the joint being perfectly loose and grating, by perseverance in proper treatment, both local and constitutional, a good and useful limb may be left; and, although there may be mobility and grating, provided there be no sign of abscess, the Surgeon should never despair of obtaining a satisfactory result.

The practice of making free incisions into a suppurating joint, as advocated by Gay, is a great improvement on the former method of merely puncturing it. If a small aperture only be made, air is admixed with the pus, which becomes offensive and irritating, and, being unable to escape freely, sinks to the bottom of the articulation with *débris* of the disintegrated cartilages, &c., giving rise not only to much local mischief, but to proportionate constitutional disturbance. By freely laying the joint open, all this is prevented; exit is given to the pus through one or two incisions that extend the whole length of the articulation; no constitutional disturbance can occur from pent-up and putrid matter, and the joint has a better chance of healthily granulating.

After the formation of abscess the prognosis is most unfavourable, especially when large joints such as the knee or hip are affected; or when those are implicated which are important to life, such as the articulations of the vertebræ; so, likewise, when the articular ends of the long bones are affected, it is seldom that the joint can recover itself, as caries or necrosis are complicating its disease and keeping it up. When the articulation is very sinuous, as in the carpus, or when a number of small joints communicate with one another, if not directly by synovial membrane, at all events indirectly through the medium of ligament and of fibrous tissue, as in the tarsus, a cure can scarcely be anticipated. In all these cases, hectic and great constitutional irritation usually come on. Pyæmia is not unfrequently developed, or, the joint becoming useless or cumbersome, its removal must be practised either by excision or amputation.

The result will at last in a great measure depend upon the state of the bones that enter into the conformation of the joint. If these be sound, or not primarily affected, and the patient's constitution has got over the effect of the occurrence of suppuration in the joint, ankylosis more or less complete may be confidently looked for. Bnt if the articular ends of the bones be primarily or deeply implicated, then excision or amputation will be the only alleviation.

When an inflamed joint, whether it have suppurated or not, appears to be disposed to undergo a cure, its repair must be facilitated by keeping it in a proper position, such as will be most useful to the patient in after-life, should it become stiff; the straight one for the knee and hip, and the semiflexed for the elbow. When the ligaments have become softened so as to admit of lateral mobility, very special attention will be required to prevent displacement of the osseous surfaces from one another, either laterally or antero-posteriorly; this may be produced partly by the weight of the limb, partly by the traction of the muscles. Any neglect of proper precautions in the more minute details of the application and adjustment of proper apparatus may be followed by a very considerable amount of deformity. Should the limb already unfortunately have assumed a faulty position in consequence of the Surgeon neglecting to support it properly in splints in the early acute stage, the patient may be anæsthetised, and the limb slowly and gently placed in such a position as will be most conducive to his after-comfort. It may be useful to strap the joint firmly in the proper position, in the way recommended by Scott when it is the knee that is affected, or by means of starched bandages when the hip or elbow are implicated. Scott's plan of treatment consists in spreading on pieces of lint the strong mercurial ointment, to every ounce of which a drachm of camphor has been added; strips of soap-plaster spread upon leather are then cut of a proper length and breadth, and the joint is firmly and accurately strapped up, the limb having previously been bandaged as high as the joint that is strapped. This dressing may be left on for a week or two, until it loosens or gives rise to irritation; over the whole a starched bandage may be applied. In many cases I have found it advantageous to strap up the joint with a plaster composed of equal parts of the emplastrum ammoniaci cum hydrargyro, and the emplastrum saponis or belladonnæ. These applications not only fix the joint and promote the absorption of the plastic matter that is deposited around it, but by acting as gentle counter-irritants, remove the remains of the inflammation that may be going on within it. If recovery have left the joint somewhat stiffened without being actually ankylosed, the natural movement must be restored by warm bathing, fomentation, friction, and passive motion. Warm water, in any way applied, is particularly and, indeed, singularly useful in a way difficult of explanation in restoring the mobility of stiffened joints.

CHRONIC RHEUMATIC ARTHRITIS.—A disease has been described especially by R. Adams and R. W. Smith, of Dublin, to which the name *Chronic Rheumatic Arthritis* has been given. It commonly affects the hip, but has been met with in the temporo-maxillary articulation and in the shoulder. I have met with cases of disease of this joint presenting all the characters of this affection during life, though, as there has been no opportunity of examining the state of the parts after death, it is impossible to speak positively as to the true nature of the disease. Chronic rheumatic arthritis is an active disease of the bones and fibrous expansions about the joint: it is especially characterised by considerable increase in the size and by alteration in the shape of the osseous structures, which become porous in some parts, porcellanous in others; by thickening of the fibrous capsule of the joint, with deposition of masses or plates of bone in it, and ultimate destruction of the cartilages and synovial membranes. The suffering is considerable; the disease greatly cripples the utility of the joint, at last produces incomplete ankylosis, and is incurable.

**Dry Chronic Rheumatic Arthritis of the Hip.**—This form of the disease commences with pain in and about the join increased at night, and especially in damp or col weather, presenting in this respect the ordinary ch racters of rheumatic affection; as the disease advance the pain, which is continuous, is much increased b standing or walking, and the movements of the joi become gradually more and more impaired. Th patient experiences the greatest difficulty in bending th body forwards from the hips; he consequently i unable to stoop, or to sit in the ordinary position, bein obliged to keep the limb straightened in nearly direct line with the trunk. The difficulty in walking in standing erect, in stooping, and in sitting increases The trochanter will be felt to be thickened, and in creased breadth of bone is distinctly perceptible i this part of the thigh. The limb, at first perhap slightly lengthened, eventually becomes shortened t the extent of about an inch or more, owing to change that take place in the head of the bone. The pelvi also assumes an oblique direction, and hence th apparent shortening becomes considerably greater The knee and foot may either be inverted or everted and the heel is raised. The shape of the hip als alters considerably; it becomes flattened posteriorly, the gluteal muscles waste so that the fold of the nates diminishes and sinks to a lower level, but the trochanter projects

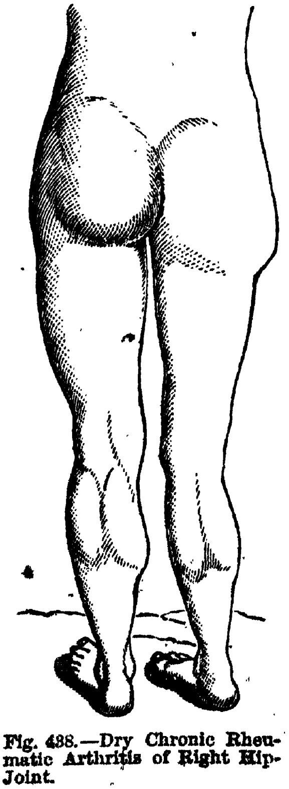


Fig. 438.—Dry Chronic Rheumatic Arthritis of Right Hip-Joint.

more than natural, and on examination seems larger and thicker than natural (Fig. 438). On rotating the limb, the movements of the bone are extremely limited, and crackling, grating, or osseous crepitation will often be felt around the joint. As Smith remarks, the lumbar vertebræ acquire great mobility, the thigh on the affected side is wasted, but the calf retains its natural size and firmness.

*Pathological Changes.*—On examination after death, it will be found that the joint, the bones, and the surrounding parts, have undergone remarkable changes. The capsular ligament is thickened, and the synovial membrane is of a bright red colour, vascular, and fringed in some parts, whilst it has disappeared in others. The round ligament is destroyed, and the head of the bone denuded of membrane, the vascular fringes being attached around the neck. The head of the bone becomes remarkably altered in shape, being flattened, greatly increased in size, or placed more or less at a right angle with the shaft, sometimes elongated, and always very irregular and tuberous. The neck is more or less absorbed, and in some cases appears as if it had undergone fracture. The acetabulum generally becomes enlarged, sometimes of a more or less circular and flattened shape; in other cases projecting at its rim, narrowed, and embracing tightly the head of the thigh-bone (Fig. 439). Both it and the upper part of the thigh-bone become porous, and perforated with numerous small foramina. Stalactitic masses of bone and porcellanous deposits are commonly thrown out about the base of the trochanter, but more particularly along the intertrochanteric line within the capsule of the joint, and not unfrequently in the soft tissue around it. In many cases the apparent increase in the size of the head of the bone is dependent on the depositions of these masses of osseous tissue upon it, rather than on any expansion or osteoporosis of the upper articular end of the thigh-bone. These masses of bone constitute one of the most important characters of the disease, and it is their presence that communicates the peculiar crackling that is felt in the hip during life. The muscles and soft structures in the vicinity of the joint are necessarily wasted, partly from disuse and partly from the pressure of the morbid masses of bone.

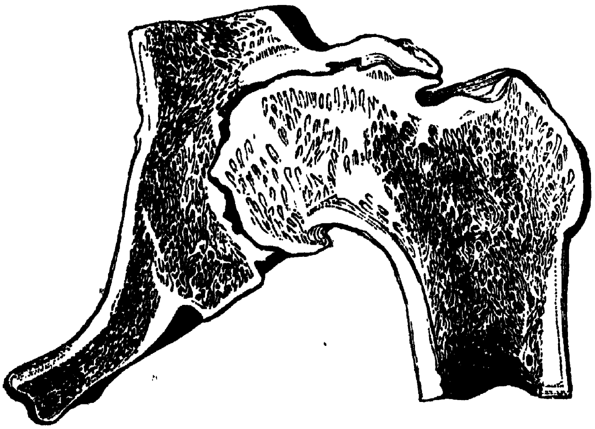


Fig. 439.—Section of Hip-Joint affected by Dry Chronic Rheumatic Arthritis.

Billroth, who has recently and most carefully studied the pathology of chronic rheumatic arthritis, gives the following account of its origin and course.

The disease commences in the cartilage, and secondarily affects the synovial membrane and bone. The cartilage is at first found rough and nodular, and the intercellular substance becomes broken up into filaments. The cartilage-cavities are enlarged and contain an excess of cells, but these new cells retain the type of cartilage-corpuscles. The breaking up of the intercellular substance into filaments is characteristic of this disease. The cartilage so altered is gradually worn away by the friction of the joint. When the bone becomes exposed, the mechanical irritation to which it is subjected causes the formation of a small quantity of new bone by ossification of the cancellous tissue. The new bone so formed is constantly being worn away by friction as long as motion is left in the joint. These changes are always found at the points most exposed to pressure. At the same time osteophytes grow from the bones in the neighbourhood of the joint, and there is increased vascularity of the synovial membrane, with swelling of its fringes, and a slight excess of synovia at first, which is cloudy, from containing fragments of the ground-down cartilage. The ligaments may ossify. The osteophytes are more compact in their structure than those formed in diseases accompanied by an increase of vascularity, as round carious or necrosed pieces of bone. Loose nodules of bone are not infrequently found in the subserous cellular tissue.

*Causes.*—This disease appears to be the result of malnutrition. It is not scrofulous, but occurs in persons whose health has been broken down by dyspeptic and other ailments that lead to impaired nutrition; hence it most frequently occurs amongst the poorer classes. It is commonly met with in men. It usually occurs above the age of fifty; but I have seen several instances of it in individuals little more than thirty years of age, one of whom was a woman.

*Prognosis.*—The disease is incurable, and, as it is commonly attended by much suffering, constitutes a source of great discomfort to the patient, though it is by no means dangerous to life, the disease not proceeding to suppuration, except in very exceptional cases. In fact, the tendency is to imperfect ankylosis; and the only instances in which I have seen suppuration take place have been when it has occurred in persons at an earlier period of life than usual, from thirty to forty years of age.

*Diagnosis.*—It occasionally happens that an individual labouring under this affection, meeting with a fall or contusion on the hip, presents signs of *fracture of the neck of the thigh-bone*, such as shortening, eversion, with some crepitation perhaps, and inability to move the limb. The diagnosis may in general readily be effected by attention to the history of the case, and by eliciting the fact that the symptoms have existed to some degree before the accident, although the pain and immobility may have been increased by it.

*Treatment.*—Little can be done to cure, but much to relieve and retard. Rest and the continued application of warm or stimulating plasters will afford relief; and, in many instances, the administration of the iodide of potassium with sarsaparilla will lessen the nocturnal pain. Smith recommends an electuary composed of guaiacum, sulphur, the bitartrate and carbonate of potash, and ginger, with a small quantity of rhubarb; and I have certainly seen benefit result from the administration of this remedy in some cases. Ammoniacum and cod-liver oil are both extremely useful in some cases. When the disease is once fairly established, and has assumed a very chronic character, it will be found of great importance to give the affected joint as much rest as possible, without confining the patient to the couch or house. This is best effected by his wearing a proper supporting apparatus. This should consist of a firm leather pelvic band having a steel rod extending down the outside of the limb, hinged angularly opposite the hip, knee, and ankle, and fixed into a socket in the sole of the boot, and properly adjusted by means of straps and moulded leather to the thigh and leg. By the use of this apparatus the weight of the limb is taken off, and all rotatory movement of the hip is prevented, to-and-fro motion being allowed.

**Dry Chronic Rheumatic Arthritis of the Lower Jaw.**—Chronic rheumatic arthritis has also been described by Smith as occasionally affecting the temporo-maxillary articulation in individuals of rather advanced life. This disease is mostly symmetrical, and gives rise to an enlargement of the condyle of the jaw, which can be felt under the zygoma, attended with much pain in opening the mouth, a sensation of cracking or grating in the joint, and some enlargement of the lymphatic glands by the side of the neck. The pain is generally increased at night, and influenced by the state of the weather. The face becomes distorted, the affected side of the jaw projecting and being pushed towards the opposite side ; but when both joints are affected the chin projects, the entire jaw being drawn forwards. This distortion is chiefly owing to the destruction of the articular eminence ; for, when this takes place, the external pterygoid muscle draws the jaw forwards and to the opposite side ; but when both articulations are equally affected, those muscles displace it directly forwards : the glenoid cavity becomes enlarged, the fibro-cartilage disappears, and the condyle is sometimes greatly thickened and flattened, and always rough, being devoid of cartilage. In such cases there is little to be done by medicines ; but the treatment must be conducted on the same principles as in the same affection attacking the hip.

**Dry Chronic Rheumatic Arthritis of the Shoulder.**—When it affects the shoulder, chronic rheumatic arthritis gives rise to a considerable enlargement of the head of the humerus, wasting and rigidity of the deltoid, and inability to move the elbow upwards, except by the rotation of the scapula on the trunk. In fact, the scapulo-humeral articulation being fixed, all movements of the shoulder are effected through the medium of the scapula, which becomes more mobile than natural. The articulation is the seat of much pain, lancinating at times, but generally gnawing and intermittent, being dependent on the state of the weather, and greatly increased in cold and wet seasons. The whole of the arm becomes wasted, and weakened in power. In two instances I have seen this disease in young and otherwise robust and healthy men, between twenty and thirty years of age, coming on without any apparent cause. In both cases the joint continued permanently rigid, though the pain was relieved by the use of the iodides and by local counter-irritation.

CHRONIC STRUMOUS ARTHRITIS : WHITE SWELLING.—By **White Swelling** is meant a very chronic form of arthritis occurring in scrofulous subjects.

This condition has not in many cases any definitive starting point, but appears slowly to supervene upon some slight injury, as a twist, or blow, or strain ; at other times it commences with a subacute synovitis, assuming its peculiar characters by occurring in a strumous constitution, and is especially liable to happen in children and females.

*Symptoms.*—The disease presents peculiar characters. The affected joint is enlarged and rounded, the bony prominences being effaced by an uniform, doughy, semi-elastic, or pulpy swelling, occupying the interstices of the articulation. The integuments covering it preserve their white colour: there is usually but little pain felt, except in moving the limb; and the position is always that in which the patient has most ease, the joint being generally semi-flexed. There is a degree of stiffness and rigidity in the joint; and, in consequence of the wasting of the limb from disuse, the affected articulation appears more swollen than it really is. The general health does not appear at first to suffer much; but, as the disease advances, symptoms of irritation and hectic declare themselves. This affection is always characterised by a special tendency to run on to suppuration, and in the majority of cases at last passes into this condition, although the tendency may be checked by proper treatment. The joint suffers from exacerbations of intercurrent attacks of inflammation, the limb swells and becomes œdematous, and abscess finally forms in and around the joint; often around, before it takes place within. When this is opened the constitutional symptoms become more severe, hectic speedily sets in, and strumous deposit in other organs, such as the lungs, at last carries off the patient.

*Pathological Changes.*—In this affection the tissues immediately external to the joint, as the fibrous capsule and the investing areolar membrane, are always much thickened and infiltrated with fatty and plastic matter; and the great tendency of this gelatinous infiltration to run into unhealthy suppuration greatly adds to the mischief that ensues. In the interior of the joint, we find much the same kind of changes that have been described as characterising acute arthritis; the cartilages have lost their polish, their elasticity, and their firm hard section, being softened, eroded, and disintegrated; the synovial membrane is removed in parts, and is here and there vascularised; in others it is replaced, together with the cartilages, either by large quantities of the semi-transparent gelatinous-looking fatty deposit, or by the pulpy grey or brownish fibro-cellular material that is met with in arthritis. The ligaments are inflamed, softened, and destroyed, being converted into somewhat similar materials; and the interior of the joint is filled with a purulent-looking synovial fluid, thin and yellow, usually containing a large quantity of fatty matter. The bones undergo important changes in this disease, the articular ends becoming expanded and enlarged; and, though this was denied by Crowther, Russell, and others, it is affirmed by more modern Surgeons, and I have had repeated opportunities of determining the fact. In all the cases that I have examined, the osseous tisue has undergone important changes, the compact structure having become thin and expanded, and the cells of the cancellated portion filled with a bloody and fatty serous fluid; or else the bone is softened, often cutting readily with the knife, and, owing to the deposit of fat, presents a yellower and more homogeneous section than healthy bone. In some cases tuberculous matter is deposited in it, and it is that that gives rise to the vomicæ and circumscribed abscesses. From this it would appear, that the principal changes that take place in a joint affected with white swelling consist in an unhealthy strumous inflammation of the parts, and in the consequent deposition of considerable quantities of semi-transparent and lowly organised exudation matter which, in its turn, has a tendency to run into unhealthy suppuration, or to undergo fatty transformation. These fatty degenerations of the cancellous articular ends, and of the widely deposited and lowly organised exudative material, are the common results of that impairment of nutrition that results from long continued subinflammatory action.

Billroth's views on the intimate pathological changes that take place in white swelling are the most recent and exact that we possess on this subject. The following is a summary of them.

The disease usually begins with chronic synovitis. The tufts are found in this stage to be swollen, soft, and succulent, and the whole membrane is thickened. The synovia is increased in quantity and cloudy. These changes gradually increase. The synovial membrane becomes thick, swollen, red, and the tufts form masses resembling spongy granulations. These synovial outgrowths increase in size, and push in between the surfaces of the joint over the cartilages. This growth gradually spreads over the whole cartilage. At first it has no adhesion to the cartilage, but after a time it is found attached to it by vascular processes. Billroth compares it to ivy creeping over a wall, and becoming attached at parts by its roots. This structure is evidently the same as Aston Key's vascular synovial fringes (p. 221). It is around these vascular attachments that the changes in the cartilage are first noticed. The cartilage is gradually consumed, or rather converted into a tissue resembling that growing over it from the synovial membrane. The microscopic characters of this new growth differ in no way from those of ordinary granulations. The changes in the cartilage commence by proliferation of the cells, till by rapid division each cell becomes converted into a group of round cells exactly resembling those of granulations. At the same time the hyaline matrix disappears, and at last the place of the cartilage is taken by granulation-tissue. After destruction of the cartilage, similar changes proceed in the exposed surfaces of the bones. At the same time that these changes have been going on, the capsule of the joint and the ligaments have become softened, swollen, and infiltrated with young cells, the whole cavity of the joint having at last become filled with the new granulation-growth. Suppuration may occur at any spot, without necessarily extending to the whole joint. This not unfrequently occurs in the synovial pouches above the knee.

*Treatment.*—In the treatment of white swelling, we must bear in mind that we have to manage a truly scrofulous inflammation and its effects. Our first object should be to prevent, if possible, the occurrence of suppuration. In the early stage, when the affection has come on insidiously, without any very active symptoms, we must trust to general antistrumous treatment; to the influence of good diet and sea-air, and to the administration of tonics, cod-liver oil, and iodine.

In the *local* treatment there are three great principles to be carried out. 1. *Rest, with perfect immobility* of the joint, is by far the most important element in the treatment, without which all the efforts of the Surgeon to prevent suppuration and disorganisation of the joint will be futile. 2. *Compression*, by means of bandages, strapping, or splints, will aid in the absorption of the plastic effusion in and around the joint. 3. *Counter-irritation* by means of issues, blisters, or the actual cautery, must be employed. These means, to be of real service, should be used before suppuration has occurred: after this, I believe they are of no use. The limb should be put into a position which is not only most easy to the patient, but will leave it most useful should a stiff joint result. If it be one of the joints of the lower extremity that is affected, especial care must be taken that the patient do not bear his weight on it. If the symptoms be of a rather acutely inflammatory kind, a few leeches may be applied; these, however, must be used as sparingly as possible, being confined, either to the earlier stages of the disease, or to the subdual of any more active intercurrent inflammation. Rest is best secured by well-padded leather or gutta-percha splints in the earlier stages; and, at a later period, by the application of the starched bandage, well lined with cotton-wadding, to the limb. This kind of application will be found to give the most efficient support, and will keep the whole of the limb perfectly motionless, so that the patient can take open-air exercise, and walk with the aid of crutches, without risk of injuring the diseased joint. In this respect the starched bandage presents great advantages over the short leather splints often used. It may readily be cut open opposite the diseased joint, so as to admit of the application of proper dressings to it. The actual cautery is extremely beneficial in these cases, applied as directed (p. 224); or caustic issues may be put in, at a little distance from the articulation, so that there may be no risk of the inflammatory action penetrating to it.

After all inflammation has, in this way, been removed, and nothing but thickening and stiffness of the joint are left, measures may be adopted for removing these conditions, and restoring the flexibility of the articulation by frictions with somewhat stimulating and counter-irritant embrocations, and eventually its strength by douches of sea-water. The swelling and puffiness that are left, together with the debility dependent on relaxation of the ligaments, are perhaps best remedied by the use of Scott's strapping; but pressure should not be applied so long as there is evidence of active inflammation going on in the articulation, which it would certainly increase.

If abscess form, it must be freely opened by an incision of a proper length, the joint poulticed, and the patient's general health attended to, so as to promote the evolution of granulations, and prevent hectic. In these cases, if the limb can be preserved, its subsequent utility, and the patient's comfort, will mainly depend upon the position in which it is allowed to become ankylosed.

### ANKYLOSIS OR STIFF JOINT.

*Ankylosis* is invariably the result of the impairment or more or less complete destruction of a joint by inflammation, and is one of the modes by which nature effects its repair. It consists in the more or less complete consolidation of the parts around and within the articulation. It is of two kinds: the Incomplete, or Fibro-cellular; and the Complete, or Osseous.

In the **Incomplete** or **Fibro-cellular Ankylosis**, the stiffness of the joint may be dependent on four distinct pathological conditions, which may be more or less associated. 1, on thickening and induration of its fibrous capsule; 2, on the formation of fibroid bands as the result of inflammation within the joint; 3, in consequence of the cartilages and synovial membrane being in part or wholly removed, and their place supplied by a fibroid or fibro-cellular tissue, by which the articular ends are tied together; 4, by shortening of the ligaments on the side of flexion of the joint. The stiffness of the joint may be materially increased by the shortened and contracted state of the muscles around the joint. But this is secondary to, and not an essential part of, the ankylosis. The fibroid ankylosis commonly results from rheumatic or scrofulous arthritis, and is the most favourable result that can be hoped for in many of these affections, especially in the scrofulous inflammatory ones. In some cases it arises simply from disuse: the ligaments becoming shortened, and the limb becoming stiffened in the position in which it has been too long detained.

**Complete** or **Osseous Ankylosis** is of two kinds. In one, all the soft parts within the joint are destroyed, and the osseous surfaces have coalesced, or are fused together by direct bony union; this is most commonly seen in the hip, knee, and elbow (Fig. 440). In the other kind there has been fibro-cellular deposit, or degeneration within the joint; and the bones, united partly by this, are also tied together by arches or bridges of osseous matter, thrown out externally to the articulation, and stretching across from one side to the other. It has been supposed that these masses proceed from the ossification of the ligaments, or even the muscles; but from the inequality of their appearance, it is evident that they are new and accidental formations. The true or osseous ankylosis does not often occur as a consequence of scrofulous articular inflammation, but is usually the result of pyæmic or traumatic inflammation in persons of a healthy constitution. It not unfrequently happens, in old standing cases of diseased joint, that more or less complete ankylosis is taking place at one part of the articulation, whilst caries, or necrosis of the bones, is going on at others. It is usually easy to make the *Diagnosis* between fibrous and osseous ankylosis; the joint being movable, though perhaps only to a very slight degree, in the false, whilst it is rigidly and immovably fixed in the true form of the disease. But cases not unfrequently occur in which the rigidity of the structures, muscular and capsular, outside the joint, is so great in the fibrous, and the mobility of the neighbouring bones and joints so free in the osseous, that it becomes very difficult to decide to what degree the joint is stiffened. Here the diagnosis may be made by putting the patient under chloroform; when, if the ankylosis be fibrous, the joint will at once be found to yield. In fibrous ankylosis any attempt to move the joint forcibly is usually accompanied and followed by much pain, whilst in osseous ankylosis such attempts, unless very forcible, are painless.

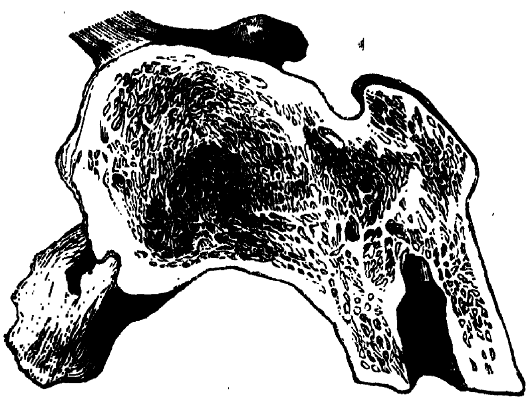


Fig. 440.—Osseous Ankylosis of Hip.

It may be observed as an additional means of diagnosis, that the fibrous ankylosis is often associated with some degree of dislocation of the bones of the affected joint; whereas in the osseous ankylosis the articular ends are usually fused together in their normal relations.

TREATMENT.—The treatment of ankylosis is, in the first instance, of a precautionary nature; that is to say, when the Surgeon finds that the establishment of ankylosis is, as it were, the natural means of cure adopted by nature in a deeply diseased joint, his efforts should be directed to taking care that the joint become fixed in such a position as will leave the most useful limb to the patient. Thus, if it be the hip or knee, the ankylosed joint should be in the straight position; if it be the elbow, it should be placed at a right angle, and the hand in the mid state between pronation and supination.

When once ankylosis has occurred, the treatment to be adopted will depend partly on the degree of stiffness, whether it be fibrous or osseous; and partly on the object to be attained, whether this be merely the restoration of mobility in a part ankylosed in a good position, or the remedying of the deformity occasioned by faulty ankylosis.

1. In attempting to restore the mobility of a joint ankylosed in a good position, as of a straight but stiff knee, the Surgeon may usually succeed if the ankylosis be only fibrous, (when some degree of movement will always be perceptible in the part,) by the employment of passive motion, frictions, and douches, more particularly with warm salt water or the mineral sulphurous springs. In the more obstinate cases, and where the immobility appears to depend, in some degree at least, on fibrous bands stretching across the joint, an attempt might be made to rupture these subcutaneously. In doing this no mischief can result; for, the synovial structure of the joint having been destroyed, no dangerous amount of inflammation can be set up in it.

Sayre has established an important point in the distinguishing of those cases in which it is necessary to cut a contracted tendon or fascia, and those in which it will yield by stretching without division. It is this; if, when the part is stretched to the utmost firm point and pressure is made on it with the finger, reflex action be induced, then it must be cut. If no reflex contraction ensue, then stretching is sufficient.

2. When fibrous ankylosis has taken place in a faulty position—if, for instance, the knee be bent, or the elbow straight—the first thing to be done is to place the limb in such a position that it will be useful. This may most readily be done by putting the patient under the influence of chloroform, and then forcibly flexing or extending the limb as the case may require, when with loud snaps and cracks it will usually come into proper position. Should any of the tendons or bands of fascia near the joint appear to be particularly tense, they may be divided subcutaneously. Either some days before the extension is attempted, or else if it have been carried as far as the rigid state of the tendons will permit, tenotomy may be practised, and, an interval of a few days having been allowed to elapse, extension may be completed. The muscular contraction will however, in many cases, yield to gradual extension by means of screw splints or weights, and thus render tenotomy unnecessary. The inflammatory action that follows this forcible extension or flexion of the limb, is usually but very trivial; an evaporating lotion and rest will speedily subdue it. Indeed, it is surprising what an amount of violence may be inflicted on an ankylosed joint without any bad consequences ensuing. After the limb has been restored to its proper position, passive motion and frictions may tend to increase its mobility.

3. When osseous ankylosis has taken place, and the position of the limb is a

good one, it will generally be wiser for the Surgeon not to interfere; except in the case of the elbow-joint, which, in these circumstances, may be excised with advantage, so as to substitute a movable for an immovable articulation. If the position be faulty, the osseous union may be sawn, drilled, and broken through subcutaneously; or a wedge-shaped piece of the bones may be taken out, and the position of the limb thus rectified.

4. Amputation may be required in cases of faulty ankylosis with so much atrophy of the limb as to render it useless, or in cases in which there is necrosed or carious bone co-existing with ankylosis and rigid atrophy of the muscles of the limb.

### LOOSE CARTILAGES IN JOINTS.

It sometimes happens that the synovial membrane of a joint assumes a **Warty Condition,** as the result of chronic irritation of the articulation. This warty state of the membrane usually consists of flattened fibroid deposits upon its surface. In other cases these may become pedunculated, and pendent into its interior. For this condition, which gives rise to occasional uneasiness and puffiness about the joint, with a crackling or creaking sensation when it is moved, but little can be done beyond the application of discutient plasters and the use of elastic bandages.

**Loose Cartilages,** as they are termed, are not unfrequently met with in the different articulations. In many cases they are not truly cartilaginous, but appear to be composed of masses of condensed and indurated fibroid tissue, not very dissimilar in structure from the warty synovial membrane just referred to, and from which they appear to be detached. In fact, the flattened and tuberculated fibroid deposits forming warty growths, the pedunculated fibroid masses, and the same detached or lying loose in the interior of the joint, appear to be successive stages or conditions of the same pathological formation. Though commonly fibroid, it is probable that in some cases these bodies may be truly cartilaginous. There can be no doubt that occasionally they are portions of articular cartilage which have been chipped off by some injury.

CHARACTERS.—These bodies vary in size from a barley-corn to a chestnut. When small, they are round; when large, they are somewhat flattened or depressed on the surface. They are smooth, shining, and usually of a yellowish or greyish-white colour. They are most frequently met with in the knee; but not uncommonly occur in the elbow or the joint of the lower jaw, and occasionally in the shoulder. Most commonly only one is found; but their number may range from this up to fifty or sixty.

SYMPTOMS.—The severity of the symptoms will to a great extent depend upon the mobility of the loose cartilage, and its consequent greater or less liability to be nipped between the opposite articular surfaces in the movements of the joint. When these bodies are tolerably firmly attached to the synovial membrane, they may merely occasion weakness of the joint, with occasional synovial effusion. When loose they usually give rise to a very distinct train of symptoms. The most marked of these is the very severe pain which occurs in particular movements of the limb. This comes on suddenly, prevents the patient from either straightening or flexing the joint completely, and is often so intense as to cause faintness or sickness. It is usually followed by a degree of synovial inflammation, and by relaxation of the ligaments. These attacks of pain and of sudden irritability of the part come on at varying intervals, as the result of movements of it: they commonly happen in the knee whilst the patient is walking. It is difficult to say to what this severe pain is due. Richet thinks it may be owing to the synovial membrane being pinched between the foreign body and one of the articular surfaces. I think that it is most probably due to the foreign body being drawn in between the opposite surfaces of the joint, when these are separated anteriorly in the act of flexion of the knee, and then, when the limb is extended, acting as a wedge between these, tending to keep them separate and interfering with the complete straightening of the limb. In consequence of this wedge-like action of the loose cartilage the ligaments are violently stretched, and the sickening pain consequent on this act is experienced, followed, as happens in a violent sprain, by rapid synovial effusion. The sensibility of the ligaments of a joint is of that peculiar nature that it is only called into action when an attempt is made to stretch them, and thus forcibly to counteract or destroy their natural use. Ligaments may be cut without any suffering, but they cannot be stretched, either by accident or disease, without the most severe pain. In some cases the loose cartilage can be felt by carrying the finger over the joint, when it may be detected under the capsule, slipping back when pressure is exercised upon it, and often possessing great mobility, gliding from one side of the joint to the other, so as to be extremely difficult to be fixed.

Treatment.—The palliative treatment consists in supporting the joint with an elastic bandage or knee-cap, so as to limit its movements, and thus prevent the liability to the recurrence of the attacks of pain; and in this way the fixing and ultimate absorption of the cartilage may sometimes be obtained. This I have several times seen to occur in patients who either refused to be operated on, or in whom an operation was not thought advisable. Any inflammation that has been excited requires to be subdued by proper antiphlogistic treatment.

If the cartilage occasion great and frequent suffering, so as to interfere seriously with the utility of the limb, and if it appear to be of large size, and to be loose and single, means may be taken for its extraction. But it must be borne in mind that, whilst the loose cartilage is at most an inconvenience, though perhaps a serious one, any operation for its removal by which the joint is opened, becomes a source of actual danger to limb and even to life. It is far less dangerous, in fact, to leave the foreign body than to perform the operation necessary for its extraction. Hence an operation should not be lightly proposed or undertaken, without warning the patient of the possible consequences that might follow. No operation should be undertaken so long as the joint is in an irritated state, as the result of a recent attack of pain and inflammation; this must be first subdued, and then the operation may be proceeded with; nor should it be done if the patient's health be broken. The extraction used to be effected by directing the patient in the first instance to make those movements by which he usually gets the cartilage fixed in the joint. So soon as the Surgeon feels it (as this operation is commonly required in the knee), he should push it to one side of the patella, where he must fix it firmly with his forefinger and thumb; he then draws the skin covering it to one side so as to make it tense, and cuts directly down upon the cartilage by a sufficiently free incision to allow its escape. The wound, which, when the skin is relaxed, will be somewhat valvular, is then closed by a strip of plaster and the limb is kept at rest for a few days until it has united. Severe inflammation of the joint less frequently follows this coarse operation than might have been expected, the synovial membrane having probably undergone some modification of action that renders it little liable to this process. It has, however, happened, that acute synovitis has set in, and this has terminated in suppuration of the joint, causing the patient's death, requiring amputation, or leading to ankylosis.

It has been proposed by Chassaigne, in order to obviate the dangers of direct and open wound into the joint, to remove the loose cartilage by subcutaneous section; this he accomplishes in a way that I have seen practised by Liston, and have often done myself, viz., by passing a tenotome obliquely under the skin, after fixing the foreign body in the way that has already been described, dividing the synovial membrane freely, and then squeezing the cartilage into the areolar tissue outside the joint, where it is finally fixed by plaster and bandage, and then may be left to be eventually taken up by the absorbents of the part. Goyrand recommends the same subcutaneous mode of removal of the foreign body from the inside of the joint; but, instead of leaving it to be absorbed, extracts it at the end of eight days, by a fresh incision, from the areolar tissue in which it has been lying.

A most useful modification of this method has been practised by Square, of Plymouth; it consists in fixing the loose cartilage, dividing the capsule subcutaneously over it, and then pressing the foreign body into the opening thus made, retaining it there by a compress and plasters. In operating by this method on the knee, the cartilage should be fixed below and to the inner side of the patella, between it and the head of the tibia; a long narrow tenotome is then introduced obliquely under the skin from a distance of about two inches below the loose cartilage; the capsule of the joint is freely divided, the subcutaneous areolar tissue freed by a slight sweep of the blade, and the loose cartilage then pressed into the cavity thus made to receive it, and slid along the areolar tissue for about three inches. It is fixed *in situ* with a firm pad and adhesive plaster; the foot and leg are bandaged up to the edge of the cartilage, and the limb is placed on a splint. If no inflammatory symptoms ensue, the cartilage is excised about a week after the operation; or it may be left to be absorbed. By the adoption of these subcutaneous methods, there will be but very little danger of inducing undue inflammation in the joint, the entrance of air being prevented, which, and not the mere section of the capsule and synovial membrane, constitutes the chief risk. Should there be more than one loose cartilage, the operation must be repeated, but not until any inflammation induced by the former one has been subdued. In this way I have successfully removed in succession five loose cartilages from one knee.

### NEURALGIA OF JOINTS.

*Pain* of a severe character is often experienced in or around a joint, closely simulating, but not dependent upon, inflammation or other structural disease.

This pain, which is purely neuralgic, may either have its origin in some local irritation of a nerve leading to the sensitive part, or it may be dependent on constitutional disorder of an hysterical character. It is this class of cases, occurring in young women who are either the subjects of hysteria, or are of a highly nervous temperament, that should especially be considered as **Neuralgia of the Joints**, to which the attention of the profession has principally been directed by the labours of Sir B. Brodie.

SYMPTOMS.—It is generally found that the hip, knee, ankle, or shoulder is the joint affected—the hip and the knee more especially. The neuralgia is usually localised in a particular joint by some slight injury that the part has sustained. But it is important to observe that in these cases the pain often does not develop itself for some days, or even weeks, after the injury that is the alleged cause of it. Severe pain in the joint is complained of; and the limb is rendered comparatively useless, often with a good deal of distortion or contraction. On examination, it will be found that the pain, which is commonly very severe, is superficial and cutaneous, not existing in the interior of the articulation, nor increased by pressure of the articular surfaces against one another; and that it is not strictly confined to the joint, but radiates for some distance around it. This pain is often intermittent in its character, and is frequently associated with neuralgia elsewhere, as in the spine; and not unfrequently with uterine irritation or disease. At the same time, it will be observed that all the signs that ought to accompany a severe attack of inflammation in a joint, such as would be attended by a corresponding amount of pain, are absent; there being no painful startings of the limb at night, no heat, redness, or swelling of it, nor constitutional fever and irritation; and the suffering being increased by causes, such as mental and emotional disturbance, that do not influence organic disease. Attention to these various circumstances will usually enable the Surgeon to diagnose the nature of the attack without much difficulty; the only cases in which he will really experience any, being those in which the tissues around the joint have been thickened, indurated, and altered in their characters by the application of issues, moxæ, &c.; or by some slight articular disease having at some time existed, but having been cured.

CAUSES.—The neuralgia is often referable to the irritation of some particular nerve, either at its origin or in its course. This is particularly the case with neuralgia of the hip and knee, which will often be found to be dependent on irritation of the obturator nerve, owing to intrapelvic inflammation, congestion, or adhesion. In one case of secondary abdominal cancer under my care, the patient was seized with the most intense pain in the right hip and knee, so as to lead to the suspicion that these joints were diseased. On examination after death, it was found that the pain resulted from the implication of the obturator nerve in a mass of intrapelvic cancer, the joints themselves being perfectly sound.

TREATMENT.—The treatment must be constitutional, directed especially to re-establish a healthy condition of the uterine organs. If there be amenorrhœa and anæmia, aloëtics and the preparations of iron must be given; if uterine irritation or ulceration exist, this must be removed by proper local means, and the general health attended to. General nervine antispasmodics and tonics, such as valerian and bark, or assafœtida and quinine in full doses, should be freely administered. The most efficient treatment that can be directed to the affected joint is the application of cold douches and the employment of the continuous electric current, which will cure cases in which all other means have failed; the application of atropine and aconite may be of service to allay the pain when especially severe. If contraction or other distortion of the limb exist, the patient should be put under chloroform, and extension or rectification of faulty position then made, care being taken to keep the limb on splints in a proper position for some time after the operation.

# CHAPTER XLIX.

## EXCISION OF JOINTS.

HISTORY.—The operation of resection of the articular ends of bones dates from the very earliest periods of Surgery of which we have any record. Hippocrates (in his Chapter on Injuries of Joints) speaks of resections of bones at the joints, whether of the foot, the hand, the leg, the ankle, the fore-arm, the wrist, as being for the most part unattended by danger, except from syncope or consecutive fever. Celsus, in speaking of compound dislocations, says, if the bare bone project it will always be an obstacle to reduction; that which protrudes should therefore be cut off. Paulus Ægineta says that, if a bone project, as after a transverse fracture, we must cut it off. Thus, it will clearly be seen that it was the practice of the ancients in compound dislocations, and in compound fractures, to resect the protruding bones. But that the practice of resection in cases of disease was not unknown to them, is also evident from a passage on fistulæ in the works of Paulus Ægineta, who directs that, if the fistula terminate with a bone, and if that be not diseased, it should only be scraped; but if it be carious, the whole diseased portion should be cut out with chisels; and, if necessary, it may have a hole bored in it with a trephine; and a little further on he says, "the extremity of a bone near a joint, if diseased, is to be sawn off; and often, if the whole of a bone, such as the ulna, radius, tibia, or the like, be diseased, it is to be taken out entire." Nothing can probably be more explicit than this statement, in which the practice is alluded to as of frequent occurrence. But he makes exceptions in the case of the bones of the spine and pelvis, and the head of the femur, which, he says, should not be operated on for fear of the neighbouring arteries.

The practice of resection thus known to and adopted by the ancients, and mentioned by the Arabian writers of the middle ages, fell completely into disuse, and seems entirely to have been forgotten until the middle of the last century, when occasional notices of its adoption appear in Surgical essays. It was first employed in cases of compound fractures and dislocations of joints. In military practice, the Surgeon, in two or three instances, picked out and cut away fragments of the bones forming the wrist, elbow, shoulder, and ankle joints when shattered by gun-shot. This early revival of resection involved no principle of treatment: imperfect operations being simply had recourse to on the field of battle as a matter of convenience in particular cases. The Surgeons who performed them did not recognise any new rule of practice as being involved in these chance procedures.

The first resection practised for injury in which the articular ends in compound dislocations were fairly, deliberately, and successfully removed, appears to have occurred to Cooper of Bungay, before or at latest about the middle of the last century. The precise date of this case is unknown; but Gooch writing in 1758, says that it occurred "many years ago;" that the ends of both tibia and fibula were sawn off in a compound luxation of the ankle; that the limb was preserved, and was so useful that the patient was able to walk and gain his livelihood.

In or about the year 1758, Wainman of Shripton sawed off the lower end of the humerus in a case of compound dislocation of the elbow-joint with perfect success, the patient recovering with an arm as movable "as if nothing had ever been amiss;" and his example was shortly afterwards followed by Tyne of Gloucester, who in a similar case removed two and a half inches of the lower end of the humerus. From this period, the operation of excisions of the articular ends of bones in cases of compound dislocations and fractures into joints became an established practice, and was extensively adopted by Percy in France, who, in 1794, exhibited to Sabatier nine soldiers in whom he had successfully excised the head of the humerus for gun-shot injury; by Bilguer in Germany, and by Hey of Leeds, and by numerous other Surgeons in this country and abroad.

The first case in which a methodical attempt at resection for disease of the articular end of a bone was made occurred to White of Manchester in 1768, who thus removed a large portion of the upper part of the humerus, though it is doubtful whether he actually excised the head of the bone. However this may be, he had previously satisfied himself by experiments on the dead body that this operation was practicable. Although the head of the humerus may not have been removed by White in this case, it certainly was three years later by J. Bent of Newcastle, who in 1771 excised by a formal and pre-arranged operation the carious head of the humerus with complete success. His example was followed in 1778 by Orred of Chester, who also operated successfully in a similar case. About the same time, 1775, Justamond, Surgeon to the Westminster Hospital, removed, in a case of disease of the elbow-joint, the olecranon and two inches of the ulna.

In 1762, Filkin of Northwich removed the articular ends of the femur and tibia, together with the patella, in a man affected with disease of the knee-joint, resulting from a fall from a horse. Filkin was led to this operation as a substitute for amputation of the limb, to which the patient refused to submit, in consequence of having experimentally practised it on the dead subject. The patient recovered rapidly, had an useful limb on which he was able to walk long distances, and was certainly alive nearly thirty years after the operation. This remarkable case seems to have attracted little, if any, attention, and indeed was not published until 1790, after Park of Liverpool brought before the Profession his second successful case of excision of the knee-joint, which occurred in 1789. That Surgeon had performed his first operation of this kind most successfully, as regarded utility of limb, in 1781, apparently without any previous knowledge of the operation that had been done by Filkin nearly twenty years previously.

The example thus set by the English Surgeons was speedily followed by the Moreaus in France, who, between the years 1786 and 1789, sent various memoirs to the French Academy on this subject. The operation, however, was violently opposed by the great body of Surgeons, and, with the exception of the occasional removal of the head of the humerus, fell into almost complete neglect both in this country and abroad for a period of nearly forty years, during which time the records of Surgery do not contain as many cases in which the articular ends of bones were excised for disease.

The operation of excision of diseased joints, though occasionally practised, continued in this languid state until 1831, when it received a new and vigorous impulse, so far as its application to diseases of the elbow was concerned, by the publication of Syme's essay on that subject, and by the practice of Liston some years subsequently at University College Hospital.

In 1845 these operations were again prominently brought before the Profession by the performance of excision of the head of the femur by Fergusson; and although excision of the knee-joint had occasionally been practised by Syme, Crampton, Textor, Demme, Heyfelder, and others, it was not until its revival in 1850 by the same accomplished Surgeon, that it came to be extensively practised. Since that period, the operation of excision has been applied to almost every joint within reach of the Surgeon's knife.

Before proceeding to discuss the different resections in detail, we must endeavour to lay down some general rules for their performance in those cases in which they are alone admissible.

INDICATIONS FOR EXCISION.—The excision of an articulation may be practised for the following reasons:—

1. As a substitute for amputation in cases in which *the joint is so extensively diseased*, that the patient will be worn out by the discharge or pain, unless it be removed. Here an useful limb may be secured by the sacrifice of the diseased part.

2. In some cases of articular disease in which *amputation would not be justifiable*, excision may be done in order to hasten the cure, and thus to save years of suffering to the patient.

3. Excision may be done in cases in which *amputation is not practicable;* as in disease of the hip-joint or of the temporo-maxillary articulation.

4. As a substitute for other and less efficient treatment, in order *to restore the utility of a limb or joint;* as in osseous ankylosis of the elbow, or in faulty osseous ankylosis of the knee.

5. Excision may be required in *bad compound dislocations and fractures into joints*, especially in *gun-shot* injuries; more particularly in those of the head of the humerus, and of the elbow.

As a general rule, resections are more required for diseases of the articular ends of bones than for simple disorganisation of joints. If only the soft structures of a joint be involved, it usually happens that, without the necessity of resection or operation of any kind, an useful limb will result; in the upper extremity, with fair mobility of the articulation; in the lower with more or less complete ankylosis, sufficient for a fair basis of support. But when the constitution is very strumous, or the bones are primarily or extensively affected, we can scarcely expect that the limb will recover to such an extent as to become useful.

CONDITIONS OF SUCCESS.—For resection to succeed, the following conditions appear to me to be necessary.

1. *The disease should not be too extensive*, so that its removal would entail such an amount of mutilation of the limb, as to render it less useful to the patient than an artificial member would be. This is especially important in the lower extremity. If the bones be so extensively affected as to require to be shortened by a considerable extent—for several inches—a limb would be left, which, instead of serving as a proper basis of support to the patient, would only be an useless incumbrance. In the upper extremity, length and strength are of less consequence than in the lower; the preservation of the hand is the chief thing to aim at, and, if this be effected, the bones may be encroached on to a greater extent than is proper in the lower limb.

2. The disease for which resection is practised should be *allowed to become chronic* before any operation is undertaken : for this there are two reasons. First, in the acute stage of disorganisation of a joint, it is not always possible to say, however unpromising the case may appear, whether ankylosis may not result, so that as useful a limb would be left as could be obtained by resection. And, secondly, if the joint be excised whilst acute and active disease is going on, inflammation and diffuse suppuration of the medullary canal are liable to set in—a condition very apt to be followed by phlebitis and pyæmia. In the only fatal instances of resection of the elbow-joint that I have witnessed, death resulted from this cause; the operation having been performed whilst the articular affection was acute.

3. *The soft parts about the joint must be in a sufficiently healthy state.* There are two morbid conditions connected with the soft parts that may interfere with the success of resection. First, they may be so thinned and permeated by sinuses, and so adherent to the bones, that an insufficient covering would be left. Or, secondly, the long-continued existence of strumous disease in joints and bones may give rise to a great deposit of lowly organised plastic matter around the articulation. This material becomes insusceptible of healthy organisation, and slowly suppurates. Sinuses form in it ; the integuments covering it become blue and doughy ; and the soft parts around the seat of operation fall into a state of strumous disorganisation, that prevents alike the formation of a false joint, osseous ankylosis, or the healing of the wound, and thus leads inevitably to the ultimate amputation of the limb. Even though this exudation-matter do not exist in large quantity, if the joint be peculiarly loose, owing to softening and disorganisation of ligamentous and tendinous structures, excision is not very likely to succeed, especially in the ankle or knee.

4. *The state of the patient's constitution* must necessarily influence the Surgeon materially in his determination whether to resect or to amputate. If the constitution be tolerably sound, or even if the general health have given way as the simple consequence of pain, irritation, and continued discharge, resection will have a fair prospect of success. In fact, when the patient is hectic in consequence of continued suppurative action, the removal of the joint or bone that maintains such action may be advantageously practised. But if there be a state of irritative fever in consequence of continuance and spreading of morbid action, the operation is likely to occasion erysipelas, phlebitis, or pyæmia, and is not a safe measure. So, also, if the constitution appear to be very much broken down, the patient being anæmic, wasted and cachectic,

with some irritative fever, but with no open abscess in connection with the joint to account for the cachectic condition, excision of the larger joints, as of the knee and hip, is not desirable. If the patient be very highly strumous, or decidedly phthisical, there will be little prospect of his being able to bear up through the long convalescence that follows resection. A slight degree of pulmonary disease, however, which appears to be rather the result of the long-continued irritation of the local affection, than of any constitutional taint, need not be a bar to operation. In such cases I have several times had occasion to observe that the general health improved rapidly after the removal of the local disease.

5. *The extremes of life are unfavourable* to resections. In very early childhood, these operations are seldom necessary; the natural processes usually sufficing, with very little assistance, to eliminate diseased bone, and the disorganised joints admitting readily enough of ankylosis. If the disease be too severe for this, it will usually be found to be associated with so strumous a constitution as to interfere with healthy reparative action of any kind. Another serious objection to these operations in young children is that, should the epiphyses be removed, the development of the limb will be arrested to a great extent, if not entirely. At advanced periods of life, destructive joint-disease is not very common, and when it does happen, it is generally in constitutions not fitted to stand up against the prolonged drain consequent on these operations. It is at the early adult age when the diseases most frequently occur that render resections necessary, that these operations are best borne.

REPAIR AFTER EXCISION.—The mode of repair after resection differs according to the circumstances of the operation.

When, as very commonly happens in cases of necrosis, the periosteum, thickened, infiltrated, and loosened, can readily be detached, or, indeed, is already separated, without injury to itself, from the dead bone, reproduction of new osseous tissue to a very considerable extent may be expected. My own observations on the fibula, tibia, and ulna, and those of Ollier and Maisonneuve, prove the importance of the periosteum as an organ of repair after the extraction of a dead shaft or bone from within it. Repair in this way is, I believe, chiefly to be looked for in the shafts of the long bones; although some Surgeons, as Annandale of Edinburgh, have described the os calcis as having been reproduced after subperiosteal excision. The remarkable osteogenetic properties possessed by the periosteum have been fully and conclusively established by the experiments and observations of Ollier. He has shown that a bone is much more rapidly and perfectly reproduced after removal, if the periosteum be left, than if it be removed, and he states that the osteogenetic properties of this membrane are greater in the long than in the short bones. He is also of opinion that resections performed by the subperiosteal method leave better results, so far as the shape and formation of the new joint are concerned, than if this membrane be sacrificed. These observations, indeed, conclusively establish the importance of making in all cases every effort to preserve the periosteum during a resection.

When a short bone, as the os calcis, has been entirely removed, with its periosteum attached, it is never, of course regenerated, but its place is occupied by a thick, firm, fibrous cicatrix.

When partial excision of a bone is practised, the result varies according to the tissue that is removed. If a portion of the compact tissue have been cut away, callus is thrown out. If it be the cancellous structure that is scooped out, the cavity left is filled up by a dense fibrous mass which may eventually ossify.

When a joint has been excised, either osseous or ligamentous ankylosis may take place; and the Surgeon should endeavour to secure osseous union in some cases, fibrous in others. Thus, when the knee has been excised, as a sound and firm limb is desirable, osseous ankylosis should, if possible, be brought about; whilst in the upper extremity, where mobility is of more use than strength, ligamentous union is most desirable. In these cases the ends of the bones become rounded, and are united by a dense mass of fibrous tissues which envelopes them, and to which the insertions of those muscles that are naturally connected with the articular ends that have been removed become attached.

The question as to the arrest of the development of the bone, and consequently of the whole limb on which an operation of excision has been performed, is one of great practical moment. It is well known to physiologists that the longitudinal growth of a bone is chiefly carried on through the medium of the layer of cartilage by which the epiphysis is attached to the shaft, and which does not become ossified until the bone has attained its full length. It has further been pointed out by Humphry, that the two epiphyses of the long bones of the limbs do not take an equal share in this development, but that one is a more active organ of growth than the other. Thus the upper epiphysis in the humerus and tibia, the lower epiphysis in the radius and femur, are the most important in this respect. If, therefore, in an excisive operation practised on a growing child, in whom osseous development has not fully taken place, the whole of the epiphysis be removed, the subsequent growth of the bone, and necessarily of the whole limb, will be arrested proportionately to the share that the epiphysis which is so removed takes in the development of the bone. And if that epiphysis on which the length of the bone is chiefly dependent, be removed—as, for instance, the upper epiphysis of the tibia and humerus, or the lower epiphysis of the thigh-bone—the limb will continue undeveloped and useless for the rest of life.

In the adult, after ossification is completed, the epiphysis loses its importance as an organ of growth; and may be removed, if necessary, without interfering with the subsequent length of the limb, except to the extent of its removal.

**Instruments.**—The instruments required for resection are of a somewhat varied character; strong scalpels and bistouries, straight and sharp-pointed. In addition to these I have found a strong-backed, probe-pointed bistoury with a limited cutting edge, of great utility in clearing the bones. The pliers should be of various sizes and shapes (Figs. 411 to 414), and gouges will be found useful for scooping out suspicious patches on the cut osseous surfaces. For ordinary purposes, a small broad amputating saw will be found the most convenient instrument for dividing the bones; but in some cases a narrow keyhole saw, or that introduced by Butcher (Fig. 441), will answer best. The last-named instrument is especially useful when it is intended to cut the bone obliquely, or when the space is limited; for, as the blade is narrow and its angle can be changed at pleasure, any required direction can be communicated to the cut. I almost invariably use it in preference to all others in resections. But some Surgeons prefer, especially in resection of the knee-joint, a short and very broad-bladed saw; the blade being of more than sufficient breadth to take in the whole thickness of bone to be divided. The chain-saw is perhaps not used so frequently as it might be.

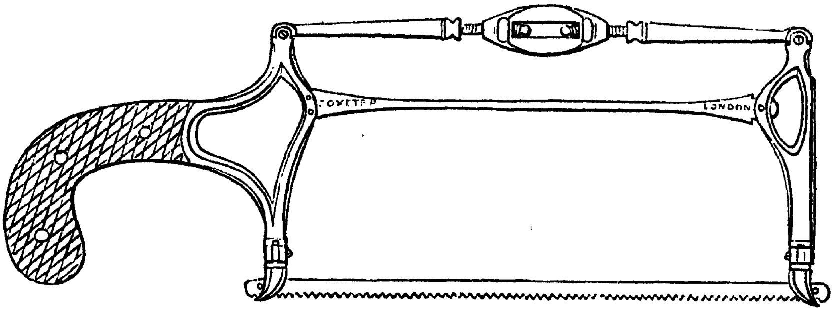


Fig. 441.—Butcher's Saw.

Operation.—The steps of the operation must of course vary with the different resections; but there are some general rules that may be laid down as applicable to all cases.

1. The incisions through the soft parts should be sufficiently free to expose thoroughly the bones to be removed. By making them, as far as practicable, parallel to tendons, blood-vessels, and nerves, parts of importance may readily be avoided.

2. As little of the bone as possible should be removed. The gouge may be applied to any carious or tuberculous cavities or patches that appear upon the surface of the freshly-cut bone; and, in this way, shortening of the bone by the saw may be materially avoided.

3. In young children the epiphysis should never be entirely removed, as it is on the growth of this portion of bone, or rather on that of the epiphysial cartilaginous layer adjoining the shaft, that the development of the bone in length is mainly dependent.

4. In adults in whom the bone has attained its maximum longitudinal development, the epiphysis may be more freely removed, if necessary. But the shaft should not be encroached upon if it can be possibly avoided, and especial care should be taken not to open the medullary canal.

5. The periosteum should be carefully preserved, being stripped off the bone where it is thickened and loosened, and manipulated very gently, so that its vitality may not be in any way impaired.

6. It is of great importance not to confound bone softened by inflammation, but otherwise healthy, or roughened deposits of new osseous matter, with that which is carious or necrosed.

7. Skin, however redundant, should seldom if ever be cut away. The flaps, at first too large, soon shrink down to a proper size, and, if trimmed, are very apt to become too scanty.

8. After the operation, light dressings only should be used. As healing

always takes place by granulation, no accurate closing of the wound is necessary, but it is sufficient to lay the limb on a pillow, or well padded splint, and to apply water-dressing. When it begins to granulate, more accurate attention to position is required.

9. The constitutional after-treatment should be nourishing or stimulating. As there will be a great drain on the system, and a prolonged confinement to bed, the strength must be kept up under it by good diet. These operations are always serious; in many cases fully as much so as the amputation of a corresponding part, or even more so, owing to the large wound that is often inflicted in the more extensive division of the bones; to the necessity of making the incisions in the midst of diseased or injured structures; and to the more prolonged character of the after-treatment. Hence it is of especial importance that the general health should be carefully maintained after these operations.

10. Should caries or necrosis return after the operation, *secondary resection* may be required. This I have done successfully at the hip, shoulder, and elbow-joints. In the elbow, in one case I performed a third resection with perfect success; the two previous operations, which had been performed by other and different Surgeons, having failed. The success of these secondary resections will necessarily be greatly dependent on the possibility of establishing an improved state of the patient's constitution.

### EXCISIONS OF THE UPPER EXTREMITY.

The whole of the upper extremity is subservient to the hand. It is to render this more widely useful as an organ of prehension and of touch that the shoulder, the elbow, and the wrist-joints are endowed with varied and extensive movements. But the movements of each one of these joints so supplement those of the others, that any one articulation may be removed, and yet the limb be left with a sufficient range and variety of movements to render the hand useful for all the ordinary purposes of life. The limb may be shortened, and it may be weakened; and yet, if sufficient length and strength be left to enable the individual to use his hand, an immense gain will result. The limb without the hand would be an useless appendage. The hand left in its integrity is useful in a great variety of ways, however mutilated the other parts of the upper extremity may be. Hence, provided the Surgeon can save the hand, he need not hesitate to sacrifice other portions of the limb; and the shoulder, elbow, or wrist, may each and severally be removed, and the patient left in the possession of a most useful and efficient member; shortened, it is true, and to a certain extent curtailed in its movements, but possessing all the delicate and intricate motions of the hand in full perfection and freedom.

SHOULDER-JOINT.—Excision of the shoulder-joint may be required for two conditions: 1. Disease, and 2. Compound and Comminuted Fracture of the articulation.

1. **Excision for Disease.**—For disease, excision is not so commonly required in this as in many other articulations; primary disease of the soft articular structures of this joint not being very frequent, and, when it happens, usually terminating in false ankylosis, without suppuration. When carious and necrosed bones are met with about the shoulder, it will frequently be

found that the coracoid or acromion processes, or the scapular spine, are at fault rather than the osseous structures of the joint itself, and extraction of the sequestra formed there may prevent excision of the articulation. In some cases a small sequestrum lying in a carious cavity in the head of the humerus may be removed by slitting up sinuses, without the necessity of excising the head of the bone.

When excision has been required for disease of the shoulder-joint, it has usually been for caries commencing in the head of the humerus, especially in children and young adults. In these cases it will be usually found that the affection is limited to the head of the bone, which is the part primarily attacked. The glenoid cavity mostly escapes entirely, or, if it be implicated, it is so secondarily and to a very limited extent. Although in malignant diseases excision has been practised, this operation is not usually advisable in such cases. Bickersteth has successfully removed the head of the humerus for exostosis. In cases of intracapsular fracture through the neck of the humerus, with detachment of the head of the bone, disorganisation of the joint has resulted. This has been laid open, and the loose head of the bone removed in two instances by Brainard of Chicago; the patients recovering with useful limbs.

**Operation.—Partial Excision** of the head of the humerus in some cases of caries has been practised by slitting up sinuses and the application of the gouge to the diseased osseous surface. Occasionally, as in cases reported by Fergusson and Sédillot, these operations have been attended by successful results. But not unfrequently they fail in effecting a cure, the disease extending, and the sinuses not healing, so that eventually excision of the whole of the diseased head of the bone has been required.

**Complete Excision** of the head of the humerus is the operation usually required. It may be practised in several different ways—the lines of incision through the soft parts being varied according to the conditions of the case. They are always made on the front or outer side of the joint through the deltoid muscle, which must of necessity be more or less sacrificed. They consist of a single longitudinal vertical incision, and its modifications the ˥ and T shaped ones, and the elliptic U or flap operation.

The operation by the *single longitudinal incision* (Fig. 442) may be performed as follows. The patient lying on his back, the Surgeon enters the knife a little to the outside and above the coracoid process, and carries it downwards for about four inches, cutting down to the bone. He then looks for the long tendon of the biceps, and if it be found still undestroyed by disease, he dissects it out from over the head of the humerus and has it held on one side with a blunt hook. The assistant then rotates the arm forcibly outwards, so as to bring the small tuberosity well into the wound, and the Surgeon divides the tendon of the subscapularis and the inner side of the capsule of the joint. The arm being now rotated inwards, the three muscles inserted into the great tuberosity and the outer part of the capsule are divided. The limb is now allowed to fall over the edge of the table, and the assistant forces the head of the bone up into the wound, whilst the Surgeon divides the posterior part of the capsule, and carefully clears the upper end of the bone all round. He now takes the limb in his own hands and, having the soft parts well retracted, he pushes the head of the bone out of the wound so as to allow the easy application of the saw by which it is removed. Should the parts around the head of the bone be thickened, unyielding, and infiltrated by plastic matter, more space may be gained by making a short cross cut at the upper end of the longitudinal incision, and thus converting it into a modification of the ┐ or ┬. By this method of operating, the posterior circumflex artery and the circumflex nerve are not divided, and but few vessels will be found to require ligature. The fibres of the deltoid are little interfered with, and if the incision be not carried too low, the insertion of the pectoralis major will be at most only partially cut through.

Should the extent of the disease or injury prove to be so great as to require the amputation of the limb, this may readily be done, as has been suggested by Spence of Edinburgh, by carrying the knife round the inner side of the limb, and so detaching the member, with due attention to those points in connection with the axillary artery that have been described at p. 74, vol. I. The result, as seen by the annexed drawing (Fig. 443), is very satisfactory.

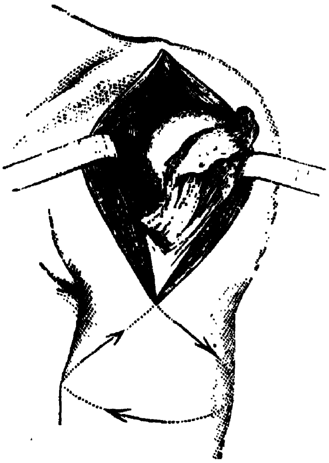


Fig. 442.—Excision of Shoulder-joint. Longitudinal Incision.

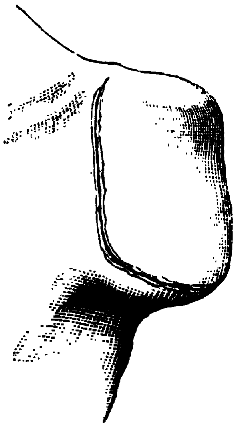


Fig. 443.—Stump after Amputation at Shoulder-joint by Spence's method.

The *elliptical operation* of excision may be performed in the following way.

The articulation may also be readily exposed by making a semilunar flap about three inches in length, commencing at the posterior part of the acromion, cutting across the line of insertion of the deltoid, and carried up to the outer side of the coracoid process. By a few touches of the scalpel, a large flap composed of the deltoid muscle may thus be raised, and the diseased articulation fully exposed. As the capsule and the ligaments are destroyed by the morbid action that has taken place in them, the head of the bone may readily be turned out of the glenoid cavity; and, being freed by a few touches of the knife, and isolated by passing a spatula behind it, may be removed with a narrow saw (Fig. 444). The shaft of the humerus should be encroached upon as little as possible, so that the arm may not be shortened more than is necessary. After the removal of the head of the bone, the glenoid cavity must be examined; if this be carious, it may be removed most conveniently by means of gouge-forceps and the gouge, care being taken that all diseased bone is thoroughly scooped away. After the operation, the flap must be laid down and retained in position by two points of suture, and the arm well supported in a sling, the elbow especially being raised. A pad should be placed in the axilla to prevent the tendency of the pectoralis major, teres major, and latissimus dorsi to draw the arm inwards. The union, which is by granulation, is usually slow, and must be conducted on ordinary principles.

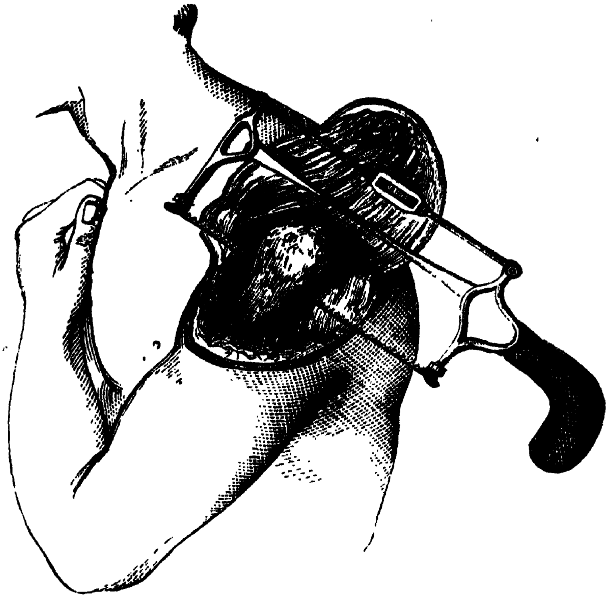


Fig. 444.—Excision of Shoulder-joint. Elliptical Operation.

*Result.*—The shoulder-joint in its normal condition possesses five distinct movements; 1. Rotation; 2. Abduction and Elevation; 3. Adduction; 4 and 5, movements in the antero-posterior direction. These movements vary greatly in importance in the course of the ordinary affairs of life. The most useful are those of abduction, and the two in the antero-posterior direction. These are requisite in all ordinary trades and for the guidance of the hand in most of the common occupations of life. The movements of elevation are seldom required except by those who follow climbing occupations, as sailors, masons, &c. Now the mode of performing the operation, as well as the operation itself, will materially influence these different movements. Thus, if the deltoid be cut completely across by means of an elliptical incision, the power of abduction of the arm and of its elevation, will be permanently lost. If its fibres be merely split by a longitudinal incision (Fig. 442), they may be preserved or regained in great part. All those movements of rotation, &c., which are dependent on the actions of the muscles that are inserted into the tubercles of the humerus will be permanently lost; for, in all cases of caries of the head of the humerus requiring excision, the Surgeon will find it necessary to saw through the bone below the tubercles—in its *surgical* and not in its *anatomical* neck. Hence the connections of the supraspinatus and infraspinatus, the teres minor, and subscapularis will all be separated, and their action on the bone afterwards lost. But those muscles which adduct and which give the antero-posterior movements, viz., the coraco-brachialis, the biceps, the pectoralis major, latissimus dorsi, and teres major, will all be preserved in their integrity; and hence it is that the arm, after this excision, is capable of guiding the hand in so great a variety of useful under-handed movements. In the case of a man whose shoulder-joint I removed many years ago, I last saw the patient about fifteen years after the operation had been performed, and then found that the upper end of the humerus had been drawn up underneath and between the acromion and coracoid processes, where a false joint had formed. The arm was extremely useful, and all the parts below the elbow were well developed. The upper arm was shortened by two and a half inches.

Excision of the shoulder-joint is on the whole a very successful operation, as regards life as well as limb. Hodges has collected 50 cases of excision of the head of the humerus for disease : of these, 8 died and 42 recovered from the operation. Of these 8 deaths, 3 only occurred before the third month, and 3 were from phthisis. In 2 only of the cases did the deaths appear to have been directly occasioned by the operation. In but 17 of these 50 cases was the glenoid cavity interfered with ; but it is a remarkable circumstance that in no fewer than 7 out of the 8 fatal cases this cavity was diseased, and required either gouging, excising, or cauterisation. Thus it would appear that the chance of a fatal termination is greatly increased by the implication of the glenoid cavity.

2. **Excision for Compound and Comminuted Fracture.**—When excision of the shoulder-joint is required for compound and comminuted fracture from gun-shot injury, the operation is of a less formal character. The bullet-holes must be laid freely open in a longitudinal direction, or the deltoid even cut across at its superior attachment, all loose splinters removed, and the ragged and spiculated ends of bone cut off with pliers or narrow saw ; especial care being taken in manipulating towards the inner and under sides of the joint, in the vicinity of the plexus of nerves and large vessels. Without going back to the earlier cases of Percy, Larrey, and other military Surgeons of the latter part of the last century, who frequently practised this operation with the happiest results, the more recent experience of the wars in Europe and America demonstrated its great utility, and that it ought invariably to be preferred to amputation at the shoulder-joint in all cases in which the large blood-vessels and nerves are intact. Hodges states that in 96 recorded cases from all sources there were 25 deaths, or a mortality of 26 per cent. But in the Crimean war the result was much more satisfactory. Thus Baudens relates 14 cases occurring in the Crimea, with only 1 death ; and in the British army, of 14 cases, 12 recovered ; whilst of 60 amputations at the shoulder-joint 19 were fatal. In the American war, the mortality in 575 cases of excision of the shoulder-joint was at the rate of 32·5 per cent. Primary excisions were more successful than secondary : the percentage of mortality in the former (252 in number) being 23·3, and in the secondary (393 in number) 38·6.

Excision of the Scapula, partial or complete, may be required for caries, necrosis, or tumour of that bone. Caries and necrosis do not very commonly affect the scapula primarily. When the bone becomes the seat of these diseases, it will generally be found that the acromion and the spine are the parts affected. In such cases the progress of disease is usually very slow, and it will generally be found that the carious bone may be effectually gouged out, or the sequestrum extracted, by laying open sinuses, and thus exposing by irregular and informal operations the diseased osseous surface. The whole bone has, however, become affected by necrosis, dry caries, and chronic inflammation to an incurable extent. In two instances the whole bone has been excised for disease of this kind following amputation at the shoulder-joint for caries of the humerus. The operators were Rigaud of Strasburg, and Fergusson. Both cases did well.

The preservation of the arm after removal of the scapula is a matter of very considerable importance. The Surgeon who first ventured on the bold operation of **Removal of the Whole Scapula** was Cumming, in 1808. Gaetani Bey, in 1830, first amputated the arm and then proceeded to extirpate the shoulder-blade. In 1819 Liston removed the whole of the upper two-thirds of the scapula from a lad without sacrificing the arm. In 1828 Luke removed nearly the whole of the scapula from a girl of fourteen for malignant disease, sawing across the bone through its neck and the root of the acromion, and thus leaving the glenoid cavity and the acromion process. Hayman, Janson, Wützer, and Textor have all performed similar operations, removing the greater part of the bone, but leaving the glenoid cavity and more or less of the parts above the spine. In 1837 Mussey (U.S.) excised the whole of the scapula and the clavicle for an enormous osteo-sarcoma; the patient, a man, was, according to Gross, in excellent health fifteen years after this operation. In 1850 Gross removed the whole of the scapula, with the exception of the glenoid cavity by sawing through the neck of the bone, for an osteo-sarcoma weighing seven pounds. Indeed, the American Surgeons have distinguished themselves highly in this department of surgery. Thus, in 1838, McClellan removed the whole of the scapula with the clavicle for encephaloid disease, but the patient died. In two cases Gilbert (U.S.) removed the scapula, half of the clavicle, and the upper extremity, one patient living a week, the other three months, after the operation. In 1845 Mussey successfully operated by the removal of the scapula, the outer half of the clavicle, and the upper extremity. In the case of Gross, the only portion of the scapula left attached to the upper extremity was the glenoid cavity. In 1856 Syme went a step further in this direction, and, by disarticulating the bone instead of sawing through its neck, removed the scapula with all its processes entire from a woman seventy years of age, also leaving the arm untouched. Since that period complete removal of the scapula, leaving the arm untouched, has been done several times by Syme, Jones of Jersey, Cock, Fergusson, Pollock, and others. The arm so left becomes useful, capable of performing all the underhand movements and of lifting considerable weights; and it may now be looked upon as an established rule in surgery that it should never be disarticulated unless it be the seat also of disease, rendering necessary that addition to the excision of the scapula. Fergusson prefers sawing through the root of the acromion to disarticulating that process, so as to give greater roundness to the shoulder and to preserve the attachment of the trapezius.

**Partial Excision of the Scapula** has usually been practised for tumours of that bone. The extent of bone requiring excision will necessarily vary greatly according to the size and character of the tumour, and the severity of the operation will mainly depend upon whether it is the upper or the lower portion of the bone that is the seat of disease. When the tumour is formed of a fibroid or osseous structure and situated towards the lower angle of the bone, it may be exposed by a crucial or T-shaped incision, and the body of the bone sawn through transversely below its neck and spine. In such cases the hæmorrhage need not be very great, as the main trunk of the subscapular artery, or even the dorsal artery of the scapula, is not necessarily divided. If the tumour spring from and be connected with the spine and acromion, only projecting forwards over the shoulder and leaving the rest of the bone sound, and the joint unaffected, it may be freely exposed, the spine of the scapula sawn or cut across with pliers, and the mass turned off from the point of the shoulder, without injury to the articulation or the implication of vessels of any importance.

When the tumour occupies the upper half of the scapula, the case is much more formidable, and the line of practice to be adopted must depend upon the parts involved. If the disease involve the body of the bone, encroaching upon the supra- or infra-spinous fossa, extending forwards into the axilla below the neck of the scapula, and thus coming into relation with the subscapular artery, it would be wiser to remove the whole bone, than to attempt the resection of the upper half, leaving only the lower angle, which would be useless to the patient.

When the body of the scapula is involved in a morbid growth, extending over the greater part or whole of the subscapular or infraspinous region, and stretching forwards under the latissimus dorsi muscle into the axilla, the case becomes infinitely more serious, as not only must the whole of the scapula be removed, but the subscapular artery must be divided, and the axillary plexus of nerves and vessels brought into the field of operation. In these cases, also, the question as to the preservation or removal of the arm has to be considered. Whenever the joint is sound, and the upper part of the limb free from disease, it should be preserved; and, as these conditions usually exist where the disease originates in the scapula, the contemporaneous or antecedent amputation of the arm is seldom required.

**Operation.**—Excision of the scapula may be performed by exposing the bone freely by means of crucial or T incisions, extending from the acromial end of the clavicle across the body and to the lower angle of the scapula. The flaps thus formed are then dissected up and turned back, the acromio-clavicular articulation, the clavicle itself, or the base of the acromion, is then to be cut through, the shoulder-joint opened, and the muscles attached to the coracoid process divided. The Surgeon may now adopt one of two courses; either dissecting at once down into the axilla, dividing and securing the subscapular artery; or he may cut across the muscles attached to the upper and back part of the scapula, pass his hand under the bone and draw it forwards, then complete the division of its axillary attachments, thus reserving the most critical stage of the operation to the last, and having the bone more fully exposed and more completely under control than when the opposite course is pursued and the operation commenced at the axillary border. In this operation the hæmorrhage is necessarily copious, and may be dangerous. In one of the earliest cases of removal of a portion of the scapula, in which Liston removed the upper part of that bone for a vascular tumour, the bleeding was frightful, and was only arrested by most energetic measures.

In all cases in which the whole of the scapula is removed, the hæmorrhage must necessarily be considerable. The suprascapular and posterior scapular arteries bleed freely, but the hæmorrhage from them and their branches is readily enough arrested. The critical part of the operation consists in the division of the subscapular artery. This should be reserved for the last part of the operation; as the vessel is cut, it should immediately be seized by an assistant and tied at once.

The after-dressing of the large wound left is simple, and is to be conducted on ordinary principles, the flaps being laid down and retained by a few points of suture.

**Result.**—The result of the operation is satisfactory, by far the larger proportion of patients on whom it has been practised having made quick recoveries from the operation, even though some have succumbed at an early period to a recurrence of the disease for which it was practised. Indeed, the danger is much less than might at first be supposed from an operation of such magnitude.

CLAVICLE.—The clavicle may require to be partially or wholly excised. In caries or necrosis of this bone, portions of it may be gouged away or extracted without much difficulty, the bone being rarely affected through its whole thickness, and its posterior part consequently not requiring removal; but when, in consequence of the growth of tumours, the removal of the whole or greater part of the bone is required, the operation is one of the most hazardous in surgery, as a glance at the anatomy of the parts lying beneath the bone, and encroached upon by the morbid growth, will indicate. In 1828 Mott excised the clavicle for an osteo-sarcoma which measured four inches in diameter. This operation was one of great difficulty; it occupied four hours in its performance, and forty ligatures were required to restrain the hæmorrhage. The subclavian vein, thoracic duct, and phrenic nerve were exposed, but the patient made a good recovery, and was alive many years after the operation had been performed. Similar operations, but not perhaps of quite so formidable a character, have been performed by Warren, Travers, Curtis of Chicago, Cooper of San Francisco, and other Surgeons. It is obviously impossible to lay down definite rules for the performance of an operation in which the circumstances must vary so greatly in each case as in this, and for the safe conduct of which the Surgeon must be mainly indebted to his anatomical knowledge. It may be stated generally that the bone requires to be exposed by a free incision along its whole length: it is then sawn across or disarticulated at its acromial articulation, and carefully dissected out in a direction from without inwards, the sternal end being forcibly twisted outwards, and its ligamentous connections carefully divided, care being taken to preserve the important vascular and nervous structures in the lower posterior cervical region, and to prevent the entry of air into any cut vein by the ligature of the vessel before its division. The sternal end only of the clavicle has been excised by Davie of Bungay in a case in which dislocation backwards had resulted from deformity of the spine, and the luxated end, gradually pressing upon the œsophagus, threatened the life of the patient. The bone was cut through by means of a Hey's saw about an inch from its sternal end, and, the sterno-clavicular ligaments having been divided, the portion of bone was forcibly elevated, and at last extracted.

ELBOW-JOINT.—In tracing the history of the introduction of excision of the elbow-joint into surgical practice, we find, as is the case in several other parts, that it was first partially and then wholly done for injury, and proposed by one Surgeon and eventually practised by another for disease.

Thus in 1758 or 1759, Wainman, in a case of compound dislocation of the joint, sawed off the lower end of the humerus just above the fossa, leaving the patient with a flexible and useful arm. Tyne, of Gloucester, did the same, removing two and a half inches of the lower end of the humerus, in a case of compound dislocation. Justamond, of the Westminster Hospital, was the first to operate in a case of disease: this he did in 1775, removing the olecranon and two inches of the ulna. Park proposed, but did not have an opportunity of practising, the complete extirpation of the joint. This was done for the first time by Moreau, senior, in 1794, and again by Moreau, junior, in 1797. Little was done from this time until the operation was revived by the Surgeons of Leeds; in 1818 by Stansfield, in 1819 by Chorley and Hey. It then made rapid progress in professional estimation, and was specially largely practised by Syme and Liston, and the Surgeons of the Edinburgh Infirmary. The excision

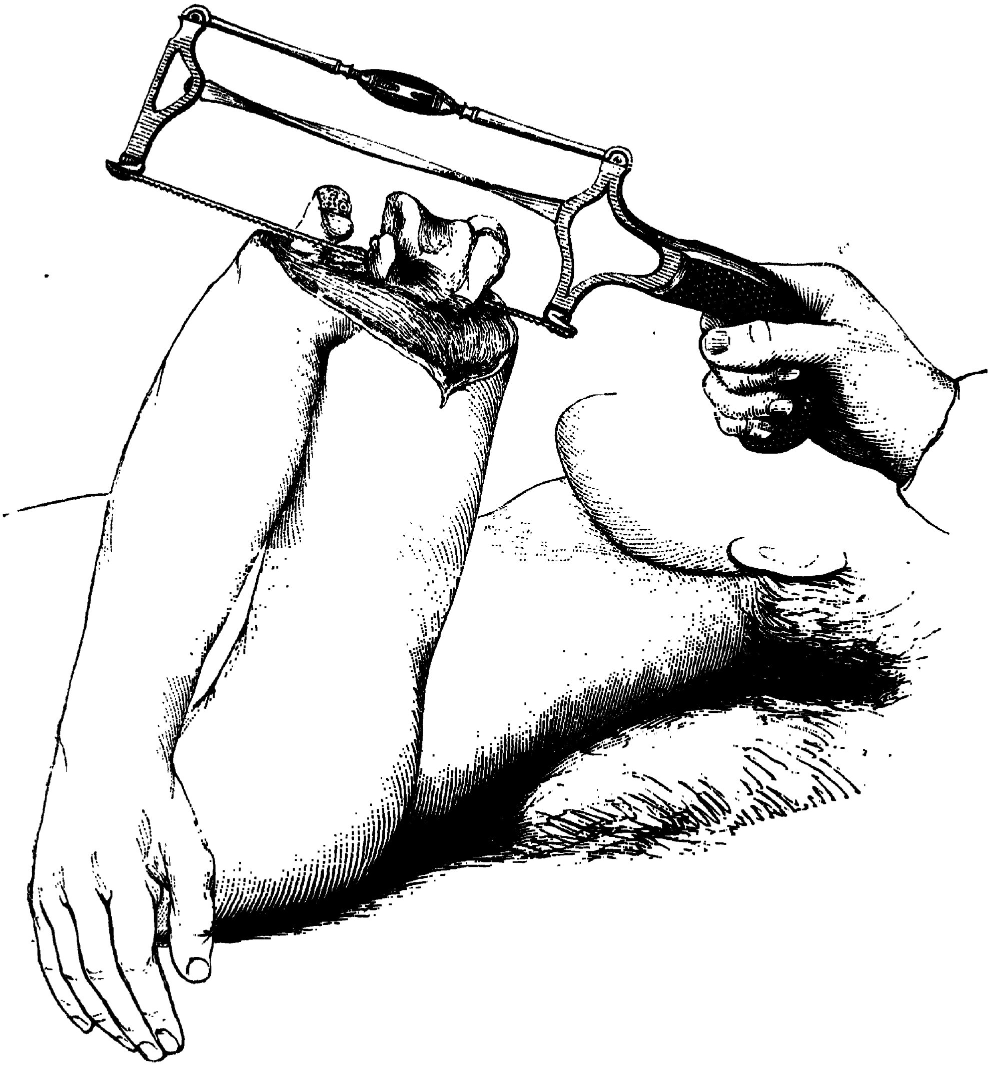


Fig. 445.—Excision of the Elbow.

of the elbow-joint has been more frequently practised than that of any other of the articulations, and the result has upon the whole been far more satisfactory.

This operation may be required, 1, for Chronic Disease of the Joint; 2, for Osseous Ankylosis; and 3, for Compound Fractures and Dislocations.

1. In cases in which the elbow-joint requires to be excised for *strumous disease* in young persons, it will generally be found that, after morbid action has existed for a considerable time in the joint, the limb will have become useless, and the soft parts around the joint swollen, spongy, and perforated by fistulous openings. When disease of this joint occurs in the middle-aged adult, the mischief will usually be found to be principally seated in the bones, the articular structures being only secondarily involved. In these cases there will often be very little external evidence of mischief, merely one or two fistulous apertures leading down to carious or necrosed bone in the condyles or the olecranon, the joint being permanently flexed and swollen, and the arm so useless that it cannot support the weight of the hand. On exposing the articulation, perhaps caries, with complete destruction of the cartilage, with or without necrosis of the articular ends, and with loose pieces of dead bone lying in the hollow of the olecranon, or in one of the condyles, may be found. Most commonly the radius is the last bone that is affected, the ulna and the articular end of the humerus being generally first diseased.

2. If *osseous ankylosis* have occurred, whether in the straight or in the bent position, excision or simple division of a portion of the consolidated bone may advantageously be practised. This operation was first done in 1827, by Rhea Barton of Philadelphia. When the elbow is ankylosed in the straight position, the arm is quite useless; and any operation by which flexion of the limb can be obtained, even without mobility of the joint, will add most materially to the patient's comfort, rendering the hand available for most purposes of life. In cases of *angular* osseous ankylosis of the elbow, the bony union should be sawn across, or a wedge-shaped piece removed, so that an useful and movable articulation may be substituted for one that is rigid and fixed.

3. In cases of *compound fracture or dislocation* of the elbow-joint, more or less complete resection of the protruding, and possibly splintered fragments, may be required (pp. 416 and 489, Vol. I.).

**Operation.**—Excision of the elbow-joint may be performed by three different procedures, viz., the H, the ⊢-shaped, or the simple longitudinal incision. Each method has its advocates. The H-shaped operation consists in making an incision parallel to, and a little to the radial side of, the ulnar nerve, another along the outer side of the joint, and uniting the two by a cross cut, dissecting up and down two square flaps, and clearing the bones laterally. It was soon found by Surgeons that by this method a very unnecessary amount of incision was practised; and accordingly the vertical cut along the outer side was dispensed with, and the ⊢-shaped operation necessarily adopted. This consists in making the longitudinal incision parallel to, and a little to the radial side of the ulnar nerve, and the cross cut over the olecranon to the outer side of the joint. More recently still, it has been found that this incision may be still further simplified, and that the cross-cut may be entirely done away with, and the operation reduced to a single longitudinal incision carried nearly over the centre of this joint in the middle line from above downwards. In comparing these different methods of operating, I decidedly give the preference to the single longitudinal incision, as being quite sufficient in all ordinary cases for the complete and easy removal of the articulation. Should the soft structures towards the outer side of the joint not yield sufficiently, a cross cut can at once be made, so as to liberate them, and give the Surgeon more room, by turning up the two triangular flaps that will thus be formed.

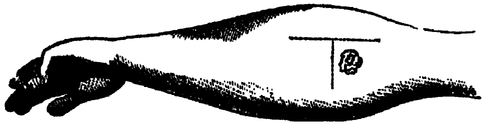


Fig. 446.—Excision of Elbow-joint : ⊢-shaped Incision.

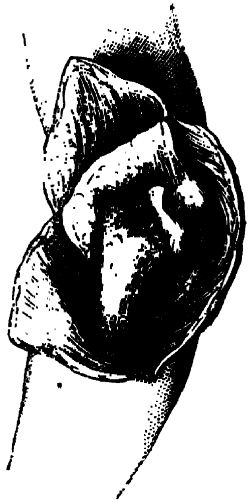


Fig. 447. — Excision of Elbow by ⊢-shaped Incision. Bones exposed. Ulnar Nerve indistinctly seen.

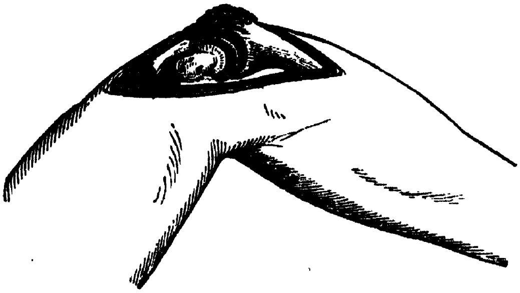


Fig. 448.—Excision of Elbow-joint by Longitudinal Incision.

The following is a detail of the successive steps of the operation as practised by the ⊢-shaped or the single longitudinal incision. The arm being held across the chest, the perpendicular cut should be made parallel to, and a line or two to the outer side of, the ulnar nerve ; being commenced at least two inches above the point of the olecranon, and carried down to about three inches below it. The transverse incision may then, if necessary, be made directly across the end of the olecranon, to the outer side of the joint, and extended as far as the extremity of the outer condyle (Fig. 446). The two triangular flaps thus made must be dissected up, the knife being carried close to the bones (Fig. 447). Or the transverse incision may be dispensed with, and the bones readily exposed and turned out by the third method, that of the single perpendicular incision (Fig. 448). This must be of sufficient length to allow of the sides being held well apart, and then it constitutes the simplest plan of excising the elbow that can well be devised. After the bones have been fairly exposed, they must be cleared to the inner side of the joint. In carrying the incision in this direction, the edge of the knife should always be kept against the bones, and their sinuosities closely followed, so that the ulnar nerve, being dissected out from behind the inner condyle, may escape injury. If the incision be properly planned, and the knife kept in contact with the bone, the nerve ought not to be exposed during the operation, more particularly as it is usually embedded in a quantity of plastic tissue. When the posterior part of the joint has been laid bare in this way, the knife should be carried round the tip of the olecranon, and this process removed by cutting-pliers. By forcibly bending the joint, pushing the forearm upwards, and lightly touching the ligaments with the point of the knife, the interior of the articulation will be fully exposed. By means of a small narrow saw, the articular end of the humerus is separated from the rest of the bone; the upper end of the ulna and the head of the radius may either be removed in this way, or by means of cutting-pliers. There is never any necessity to place a spatula before the bones, as the parts of importance anterior to the joint could not easily be wounded, being completely protected by the brachialis anticus. The ulnar nerve will occasionally, however, be in some danger, and it must be guarded or drawn on one side by a bent copper spatula. Should any sinuses exist, especially towards the inner side of the arm, they had better be left untouched. I have more than once known the ulnar nerve cut across by the Surgeon in laying open what appeared to be very superficial sinuses in this situation. In this operation it is of great consequence, so far as the after-utility of the arm is concerned, not to remove more of the bones lengthwise than is absolutely necessary; the shaft of the humerus, for instance, should never be encroached upon, but it will be quite sufficient to limit the excision to the articular surface; should any carious portions of bone extend beyond this, I think it is better to scoop them out with the gouge than to remove them in any other way. The excision of the ulna and radius should not be carried so low as to divide the insertions of the brachialis anticus and biceps. After opening the articulation, a practical question of considerable importance often arises; viz., to what extent the resection of the articular ends should be carried. If they be all diseased, there can of course be no doubt as to the propriety of removing the ends of the three bones. So, also, if the humerus and ulna be diseased, the head of the radius should be cut off on a level with the section of the ulna. But the important point is, whether, in the event of only one bone being implicated, by disease or injury, the Surgeon should limit himself to the excision of this alone, or should remove the other two. Formerly, in accordance with the principle of conservative surgery, that diseased or injured parts alone should be sacrificed, I have advocated leaving the healthy articular ends, and only removing that which was diseased; but increasing experience has convinced me that the practice is erroneous, and that, if the joint be only partially excised, ankylosis is more apt to ensue than when the whole of the three articular ends are extirpated. I would therefore advise that, in cases of caries involving the elbow-joint, the whole of the articulation be removed, as well as in those cases in which operation is required in consequence of comminuted and compound fracture of only one of the bones; as, for instance, when the lower epiphysis of the humerus, or the upper end of the ulna only, is the seat of such injury. In excision of the elbow for faulty osseous ankylosis, a piece of the united bones about three-quarters of an inch to an inch in length should be sawn out; transverse, not wedge-shaped, cuts should be made, and the piece of bone removed must correspond to and include equal portions of humerus and of ulna.

In some instances no vessels require ligature, though there may be free general oozing; but most commonly one or two must be tied. In several cases, it is said, the bleeding has proved extremely troublesome. This, however, I have never seen. After the operation, the limb should be laid upon pillows, nearly in the extended position, so that the cut portions of bones may be in close approximation with one another. If the excision have been practised through a single straight incision, there will be but little if any gaping of the wound, the flaps falling closely together. If any transverse cuts have been made, the edges cannot so readily be brought into apposition. At the end of a week or ten days, when granulations have sprung up, the arm may be put on a slightly bent leather splint, and, as the healing process goes on, this may gradually be flexed, until at last it is brought to a right angle. The fibrous union that takes place between the bones will be closer, and a more compact and useful false joint will form, than if the osseous surfaces be too widely separated in the first instance, and be allowed to unite by a lengthened ligamentous tissue. Until the contraction of the cicatrix has fully taken place, and the neighbouring tissues are quite firm, the joint should be supported by one lateral leather splint on the inner side of the arm. The splint should then be removed, the arm put in a sling, and passive motion had recourse to, in order to prevent osseous ankylosis. Should there appear to be, as sometimes happens in children, a special tendency to this, the limb may be laid, before cicatrisation has taken place, upon a splint jointed opposite the elbow. Much of the success in the result of excision of this, as of other joints, will depend upon the care and attention bestowed on the after-treatment of the case. The position of the parts and the relation of the bones to one another should be scrupulously attended to, bagging of matter prevented, and exuberant granulations repressed. At the same time, the patient's strength must be kept up by constant attention to diet, fresh air, &c. In this way good ligamentous union will take place. In two cases which I have had the opportunity of dissecting, one sixteen months and the other two years and a half after the operation, it was found that the ends of the bones were rounded and firmly united by a dense fibroid or ligamentous structure. In this way a most excellent and useful limb will result, having the four movements of flexion, extension, pronation, and supination nearly perfect, with but little deformity, as may be seen by the accompanying cut (Fig. 449), which was taken nearly two years after operation from a patient of mine. A coachman, whose elbow-joint I excised, was able to drive, to lift a pail of water, and to do all the duties of his employment, nearly as well as if the arm had retained its normal condition.

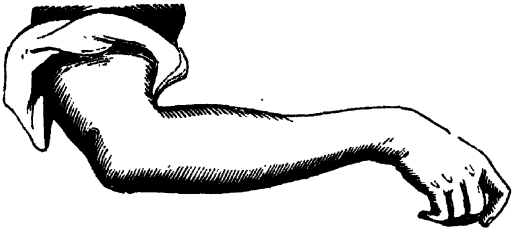


Fig. 449.— Arm after Excision of Elbow.

Should recurrence of disease take place, resection may be again resorted to with success. In one case, indeed, which had been unsuccessfully operated on twice by other Surgeons, I excised the bones about the elbow for the third time with complete success, removing a considerable portion, nearly three inches, of the necrosed shaft of the humerus, and the carious upper ends of the radius and ulna. In this case, which was that of a boy about fourteen years of age, complete recovery took place. He had a most useful arm, regaining the four movements of the joint, pronation, supination, flexion, and extension, and this notwithstanding his being of a most strumous habit. Six months after the excision he was obliged to have one thigh amputated for disease of the bone, and he eventually died at the end of two and a half years, of caries of the spine.

**Results.**—Excision of the elbow-joint, so far as life is concerned, is a very successful operation. The result, when it is practised for compound fracture or dislocation, has been already stated at pp. 416, 489, Vol. I. When practised for disease it is equally satisfactory; and indeed death can only occur from some unforeseen and accidental complication, such as may and does follow any operation. I have lost only one patient out of very many in whom I have excised the elbow-joint. The principal danger after this operation arises from diffuse suppuration of the medullary canal of the humerus. I have seen this happen in two fatal cases in the practice of others, phlebitis and pyæmia developing themselves in a secondary manner in both instances; and in a third, in which the patient lost his life, it is probable that death, which was attributed to pneumonia, remotely occurred from the same cause.

The result, so far as utility of limb is concerned, is equally satisfactory. If proper care be paid to the after-treatment, a strong arm, useful for all the purposes of life, with an articulation capable of the four normal movements of the joint, viz., flexion, extension, pronation, and supination. If the whole of the articular ends be excised, and if passive motion be employed, or the limb be kept suspended in a sling merely without splints after a few weeks have elapsed, ankylosis will but very rarely take place. Should there be danger of this occurrence, the patient should be put under chloroform, and forcible flexion and extension employed, or the limb placed on a splint with a hinge-joint and rachet apparatus, which will admit of its being moved daily by the Surgeon; care being taken that it be kept flexed rather than extended. Undue mobility is rare; I have never seen it follow excision for disease, but have met with it in one case—that of a young woman, the lower end of whose humerus was completely disorganised by a fall, and the elbow-joint opened. In this case the lower epiphysis of the humerus was excised, together with the articular ends of the ulna and radius. A good recovery took place; but, although every care was taken to support the limb on splints, a very movable joint was left. This I attributed to the whole of the lower epiphysis of the humerus having been extirpated, and the union taking place between its shaft and the bones of the forearm in an imperfect manner.

ULNA OR RADIUS.—One or other of the bones of the forearm has occasionally been excised with advantage, leaving a sufficiently useful limb with good power in the hand. Carnochan of New York and Jones of Jersey have successfully excised the whole ulna. In a case recorded, by Weist (U.S.) nearly the whole ulna was removed on account of gunshot wound. Care was taken to preserve as much as possible of the periosteum; and reproduction of the bone, forming a very useful limb, had taken place at the end of a year. Butts of Virginia has removed the whole radius. In a woman who was under my care about twenty years ago, I also resected successfully the whole radius, with the exception of its articular head, which was sound (Fig. 451); and an useful arm, of which the annexed figure is a good representation, was left (Fig. 450). After a time the hand gradually inclines towards the radial side of the arm: but, although the articulation between it and the forearm is but a slender one

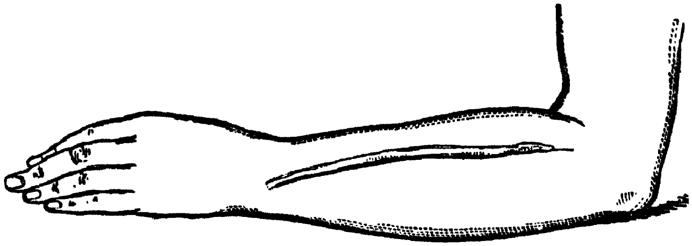


Fig. 450.—Arm from which Radius has been removed.

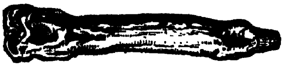


Fig. 451.—The Radius after Removal.

through the medium of the ulna, a very useful member will be left. These operations do not require any specific rules for their performance; the bone is exposed by a long incision in the direction of, and made by slitting up, the sinuses that burrow amongst the muscles, and is then carefully dissected out from the parts amongst which it lies; especial care being taken to preserve the periosteum and any new bony deposits that may already have been formed. In one case in which the elbow-joint was involved, and the radius diseased, instead of amputating the limb I obtained an excellent result by the excision of the articulation as well as of the affected bone. The patient, a builder about thirty years of age, was able, four years after the operation, to use his hand not only in all the ordinary purposes of life, but also in his trade.

The **Olecranon** has been successfully removed in some instances; for disease by Birkett of Guy's Hospital; and on account of non-union after fracture by Newman of Stamford. In each case an useful arm was retained.

WRIST.—Excision of the Wrist is an operation that has hitherto found less favour with Surgeons than the removal of other joints. Two objections have been urged against it. The first is that, when the carpus is diseased, the morbid action very often rapidly extends, with great constitutional irritation, to all the small bones that enter into its formation; and although in some cases a few of these may have been successfully taken away, yet methodical excision of the whole of the joint has either been attended by persistence of the disease in the soft parts, or followed by a stiff and useless hand and arm. The second objection to excision of the wrist consists in the superficial character of the articulation, and its close connection with the flexor and extensor tendons; hence, when the wound cicatrises, consolidation of these and of their sheaths is apt to result, and loss of that utility of hand, the preservation of which should be the great object in the performance of the operation, is entailed. I had a case, however, in 1858, in the person of a middle-aged man, in whom the whole of the carpus and a portion of the bases of the metacarpal bones were removed, and who recovered with a very useful hand, with some power of flexing and extending the wrist, and with very considerable mobility of the fingers; and within the last few years the operation has been several times performed with more successful results than had been anticipated. To Lister of Edinburgh, and West of Birmingham, is principally due the merit of showing the practicability of the operation. The mode of operating planned by the former of these Surgeons will be here described. But before giving the details of this operation, it may be well to mention the principles on which it is founded. On looking at the movements of the wrist-joint, it will be seen that they are far fewer and more limited than those of either of the other joints of the upper extremity. In fact, they are but two in number, viz., flexion and extension, and flexion can rarely be carried to a right angle. The hand as an organ may be perfectly useful though these movements be lost, and, when lost, they are supplemented by the antero-posterior movements of the elbow. But the hand cannot be left useful if the flexion and extension of the fingers be interfered with seriously. Now the essential principle of Lister's operation appears to me to consist in saving these, whilst those of the wrist are necessarily sacrificed. If we look at the tendons that surround the wrist, we shall find them divisible into five groups: 1. Those special to the thumb; 2. The extensors of the fingers; 3. The flexors of the fingers; 4 and 5. The extensors and the flexors of the wrist. Now the incisions are so planned as to save absolutely the whole of the first three groups, and only to divide the tendons of the wrist proper. Hence the result of the operation is to enable the patient to recover with good movement of flexion and extension in the fingers and of the thumb as an opponent to the hand, but with the comparatively slight inconvenience of a stiff wrist.

**Lister's Operation.**—From the result of two cases of severe injury to the wrist-joint, which recovered with useful hands, Lister was led to the conclusion that, with proper after-treatment, the tendons about the wrist might be very freely handled without permanent stiffness necessarily resulting. At the same time, he hoped by removing the whole of the cartilaginous surfaces to be able to prevent recurrence of the disease—which is the common ending of cases of partial excision of the wrist-joint for caries of the carpus. At the time when he published his papers, he had performed the operation of excision of the wrist fifteen times. The method of operating was essentially the same in all; various small details being altered as experience suggested. The operation, as he now performs it, is done as follows. Before commencing, Esmarch's bandage and tourniquet should be applied, as without them the oozing of blood interferes considerably with the operation. Any adhesions of the tendons then existing may be forcibly broken down by moving the joints. An incision is then made "from about the middle of the dorsal aspect of the radius, on a level with the styloid process, downwards and outwards towards the inner side of the metacarpo-phalangeal articulation of the thumb; but, on reaching the line of the radial border of the metacarpal bone of the index finger, it is carried downwards longitudinally for half the length of that bone." This incision should commence in the angle formed by the tendons of the common extensor of the fingers and the extensor secundi internodii pollicis, and the upper part should run parallel to the latter tendon, but without injuring it. The tendon of the extensor carpi radialis brevior will be cut, but that of the longior will escape for the present, and the angle formed by the two parts of the incision should be close to the inner side of its insertion. If the first part of the incision be carried too far, there is danger of wounding the radial artery. The soft parts are then to be separated carefully from the bones on the radial side of the incision, the tendon of the extensor carpi radialis longior being now cut as close to its insertion as possible. The tendon of the extensor secundi internodii pollicis and the radial artery are to be pushed outwards out of the way. The trapezium must then be separated from the rest of the carpus by cutting in the longitudinal part of the incision with the bone-forceps. The soft parts on the ulnar side of the radial incision are now to be dissected up as far as can be conveniently done, the remainder being raised from the ulnar incision. While this is being done, the tendons must be relaxed by extending the joint. The trapezium is not to be removed yet, as any attempt to dissect it out before removing the rest of the carpus would endanger the radial artery and the tendon of the flexor carpi radialis. The ulnar incision is now to be made. It must be a free incision, commencing at least two inches above the end of the ulna and immediately to the palmar aspect of the bone, and carried directly downwards between the flexor carpi ulnaris and the ulna, and then straight on as far as the middle of the palmar aspect of the fifth metacarpal bone. The tendons and soft parts on the dorsum of the carpus are now to be completely raised. In doing this the tendons must be relaxed, and they are to be raised as little as possible from the radius or metacarpus. The extensor carpi ulnaris is to be cut as near its insertion as possible, and the dorsal and internal lateral ligaments may now be divided. Then the soft parts are to be raised from the

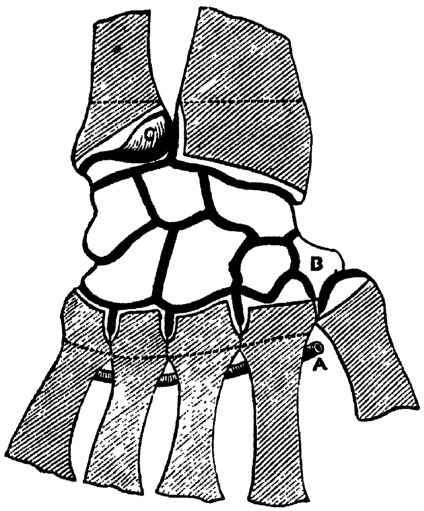


Fig. 452.—Diagram of Wrist. A. Deep Palmar Arch. B. Trapezium. C. Articular Surface of Ulna over which Radius moves. (Lister).

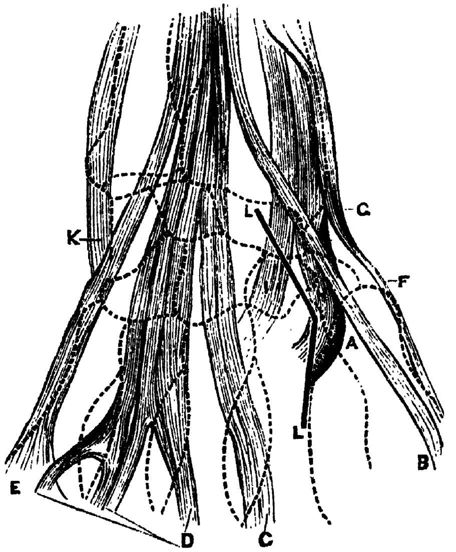


Fig. 453.—A. Radial Artery. B. Tendon of Extensor Secundi Internodii Pollicis. C. I dicator. D. Extensor Communis Digitoru E. Extensor Minimi Digiti. F. Extens Primi Internodii Pollicis. G. Extensor Oss Metacarpi Pollicis. H. Extensor Carpi Radial Longior. I. Extensor Carpi Radialis Brevior. K. Extensor Carpi Ulnaris. L.L. Line of Radial Incision. (Lister.)

palmar aspect. The knife must be carried close to the ulna, so as not to wound the artery and nerve. The pisiform bone is to be separated and left attached to the tendon of the flexor carpi ulnaris, which is not to be cut. The flexor tendons are to be raised from the metacarpal bones, but in doing this the hook of the unciform bone must be clipped off with the bone-forceps, and care must be taken not to cut below the bases of the metacarpal bones, for fear of wounding the deep palmar arch. The tendons must be relaxed during this part of the operation by flexing the wrist. The bone-forceps may now be introduced, first between the carpus and radius, and then between the carpus and metacarpus; by this means the whole of the carpal bones (except the trapezium and the pisiform bone) are separated from their connections, and may be extracted in one mass with a larger pair of sequestrum-forceps, any bands which retain them being touched with a knife.

The ends of the radius and ulna may now be easily protruded from the ulnar wound. If on examination they be found only slightly diseased, the ulna may be sawn obliquely so as only to remove its articular surface and to leave almost the whole of the styloid process. A thin slice may be taken off the end of the radius, so as only just to remove the cartilaginous surface; and its articular surface for the ulna may be removed by cutting longitudinally with the bone-forceps. By leaving the ulna as long as possible and by saving the styloid process, the tendency to displacement to the ulnar side is somewhat counteracted. If the bones be extensively diseased, the gouge and bone-pliers must be used freely. The next step is to expose the bases of the metacarpal bones, and to treat them in the same way as the radius and ulna, saving as much bone as possible, but removing all cartilaginous surfaces. The second and third are most easily protruded from the radial, and the fourth and fifth from the ulnar wound. The trapezium may then be dissected out, being held in a strong pair of forceps. In doing this care must be taken, first, not to wound the radial artery, which is in close relation with its outer side; and, secondly, not to cut the tendon of the flexor carpi radialis which lies in its groove. When the trapezium is removed, the base of the metacarpal bone of the thumb may be pushed up and cut off with the bone-pliers. It is better to remove it, as it may suffer from recurrence of the disease, and by its removal the thumb is reduced in length to the same extent as the fingers. Lastly, the pisiform bone may be examined, and either removed entirely, or its cartilaginous surface cut off, as the case requires. During the operation, the only tendons necessarily divided are the extensors of the wrist. The flexor carpi radialis may escape, from its attachment being situated low on the bases of the second and third metacarpal bones, and the flexor ulnaris is left attached to the pisiform bone. All the extensors of the thumb should be uninjured. All the tendons necessarily divided must be cut as long as possible, so that they may form new attachments in the most advantageous positions; and, in raising the flexor and extensor tendons they must be disturbed as little as possible.

*After-treatment.*—The radial wound may be closely united with sutures. The ulnar wound may be closed at each end, but the middle of the wound is to be kept open by means of an india-rubber drainage tube to allow free exit of discharge. The hand is to be placed on a splint. The most convenient is a simple wooden splint, "with an obtuse-angled piece of thick cork" stuck on it so as to maintain the hand in a state of semi-flexion, with the wrist slightly extended (Fig. 454). The thumb is supported by a bar of cork stuck on the under surface so as to project at the side (Fig. 455). The two great objects in after-treatment are to get the fingers perfectly movable and the wrist firm. For these purposes passive motion must be commenced as early as the second day in the fingers, each being bent and extended every day fully, while the wrist is kept firmly on the splint and disturbed as little as possible during the treatment of the fingers. Pronation and supination must not be too long neglected. Passive motion must be maintained as long as there is any tendency to the formation of adhesions in the sheaths of the tendons. As the hand becomes stronger, the part of the splint supporting the fingers may be cut off. The patient must continue some support as long as he feels any weakness in the wrist. There is often some tendency to dropping of the wrist to the ulnar side, which is best counteracted by a properly constructed gutta-percha splint. The thumb is apt to be drawn in towards the index finger ; this must be prevented by a thick pad of lint kept from the earliest time between the two.

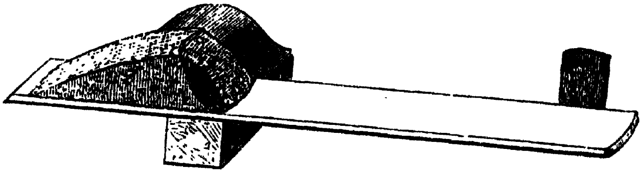


Fig. 454.—Lister's Splint with Cork Support for Hand.

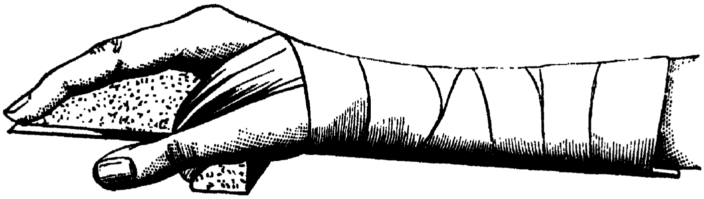


Fig. 455. - Hand after Excision of Wrist, laid on Splint.

The essential points are, first, exact attention to all the details of the operation, and next, a careful and patiently conducted after-treatment.

**Results.**—Since Lister described his method of operating, excision of the wrist for disease has in several instances been practised successfully by West (five cases), Gillespie, and other Surgeons. In military surgery, however, according to the statistics of the American war, the results of the operation have been far from encouraging in regard to the amount of mobility left to the hand.

Hand.—In the removal of diseased or injured portions of the hand, it is, as a general rule, of the greatest importance to sacrifice as little as possible of the healthy or uninjured structures. In all operations on the hand, indeed, we must have two great principles in view—the preservation of the utility of the member, and the maintenance, so far as practicable, of its symmetry. Utility is necessarily the primary consideration ; but if a part be not useful, it may, as in the case of the head of the middle metacarpal bone in amputation of the corresponding finger, be sacrificed for the purpose of preserving the symmetry of the maimed limb. The hand is the organ of *prehension* and of *touch;* and in all operations applied to it we should endeavour, as far as practicable, to maintain its efficiency in both these respects. It is also of importance to bear in mind that two great classes of actions can be carried out by the hand—those that require force, and those that require delicacy of manipulation rather than strength. By a surgical operation we may sometimes succeed in preserving one, though we are compelled to sacrifice the other; and in this respect, our procedure should be a good deal influenced by the occupation of the patient. Thus, by partial excision, we may leave a hand that would enable a clerk to hold his pen, but which would be almost useless to a labourer or blacksmith.

In looking at the hand from a surgical point of view, we may consider it as being composed of two constituents—the hand proper, and the *Thumb;* the thumb being an accessory hand, an opponent to the rest of the member, through the medium of which the movements of ab- and ad-duction are chiefly performed, and without which the member is susceptible of a comparatively limited utility, being capable of little beyond flexion and extension. Hence the thumb is of equal importance to the rest of the hand: and the preservation of its three bones is as much to be considered as that of the remaining sixteen that enter into the conformation of the metacarpus and fingers. In all cases of injury or disease implicating the thumb, every effort ought to be made for its preservation. Even if it be left stiffened and incapable of flexion, it will be a most useful opponent to the rest of the hand. Should it be found necessary to shorten it, care must be taken that as little curtailment as possible be practised: a portion of a phalanx, or its metacarpal bone even, is of essential utility in giving strength and breadth to the grasp of the hand. In cases of disease, a very useful member may be left by the removal of a portion or the whole of the ungual phalanx, of the metacarpo-phalangeal articulation, or even by the excision of the metacarpal bone, the phalanges being left. These various operations are easy of performance; an incision through the diseased and disorganised soft parts will expose the necrosed bone or carious joint, which must be removed by cutting-pliers or a narrow saw.

When the thumb has been forced back, or badly lacerated by powder-flask or gun-barrel explosions, it may often be saved by being replaced and maintained in position on a splint, with light water-dressing over it; and, should amputation be required, it must be done in accordance with the rule just mentioned, of saving as much as possible of the injured part.

In the conservative surgery of the **Fingers** the preservation of flexion and extension in the part left is the main thing to be aimed at; a rigid stump is always in the way. The preservation of these movements becomes more important in proportion as the palm is approached. It is of more consequence that the proximal phalanx, which carries the rest with it, should be capable of being bent into the palm, than that the distal can be flexed on the second. If the proximal phalanx can be bent down, a very small degree of movement in the distal one will be sufficient to furnish pliability enough in the finger to make it an useful member; but if the proximal one be stiffened, no amount of mobility in the distal phalanx can make it useful.

In preserving these movements, it is necessary to be particularly careful of the sheaths of the tendons. If they be in any way opened or injured, it will generally be found either that the tendon sloughs, or that it becomes consolidated, and matted to its sheath in such a way that all movement is lost, or at least greatly impaired.

The only phalanx that can be excised with advantage is the distal one. It often happens, in the destructive disorganisation which results from whitlow, that this necroses; when, instead of amputating the end of the finger, it may be removed by an incision on its palmar aspect. Disease of the phalangeal articulations usually leads to amputation of the affected finger. The rules for performing these various operations have already been laid down at pp. 62 *et seq.*, Vol. I., to which I must refer the reader.

Resection of the **Metacarpal Bone**, either of the thumb or index finger, without the removal of the corresponding digit, is occasionally required, more particularly in cases of injury; it may readily be done by making a longitudinal incision over the dorsal aspect of the bone to be removed, carefully detaching it from surrounding parts by keeping the edge of the knife close against the bone, avoiding the tendons, and then either disarticulating, or (what is preferable) cutting across the neck of the carpal end of the bone, turning it out, and separating it from any distal attachments which it may retain. After the removal of the metacarpal bone of the index finger in this way, but little deformity results, and a very useful hand will be left, more particularly in children, on whom I have more than once had occasion to practise this partial resection with success. If the periosteum be saved, the bone may be to some extent reproduced, but in order to obtain this result it is necessary to keep the finger drawn forwards by an elastic extending apparatus, to prevent the first phalanx from being pulled back on to the carpus by the muscles attached to it.

### CONSERVATIVE SURGERY OF THE LOWER EXTREMITY.

In all conservative operations that are practised on the lower extremity, it is of essential importance that a good basis of support, of sufficient length and stability, be left to the body. These operations differ thus in some important respects from those that are practised on the upper extremity. In the latter, the preservation of the hand, even though in a mutilated condition, is the thing at which the Surgeon aims; and, provided this be attained, it matters comparatively little how much the arm may be shortened or impaired in power. In the lower extremity, however, strength, length, and solidity are essential to the patient's comfort and utility, and unless these can be secured, his interests are better served by the removal of the limb, and the adaptation of some artificial contrivance, than by leaving a shortened, wasted, and crippled member, which is unequal to support the weight of the body.

HIP-JOINT.—Excision of the head of the thigh-bone has of late years been a good deal practised in some cases of hip-joint disease. This operation may, however, most conveniently be considered in connection with that affection (Chapter LII.).

KNEE.—Excision of the knee-joint may be required either as a substitute for amputation in cases of extensive disease and disorganisation of the articulation, or may be practised in some rare cases of faulty ankylosis resulting from old disease or injury, by which the limb has been rendered useless. This operation, originally performed at the close of last century by Park, Filkin, and the Moreaus, fell into disfavour until it was revived in 1850 by Fergusson, since which time it has been extensively practised.

**Operation.**—Excision of the knee-joint may be performed by making a horse-shoe incision with the convexity downwards, from the side of one condyle of the femur across the tuberosity of the tibia to a corresponding point on the opposite condyle (Fig. 456). By this incision the ligamentum patellæ is divided, and that bone turned up in the elliptical flap; the crucial ligaments, if not already disorganised, are then to be cut across, any remaining lateral attachments divided, and the bones cleared for the saw. In doing this the limb must be forcibly flexed, and the knife carefully applied to the posterior part of the head of the tibia; for this purpose a blunt-pointed resection-knife is the best. The articular surfaces must now be sawn off. This may be done by Butcher's saw, but in order to ensure a perfectly smooth section of the bones, many Surgeons prefer to use a common saw somewhat broader than that ordinarily employed in amputations. The lower end of the thigh-bone should first be removed, and then a slice taken off the tibia by cutting from behind forwards (Fig. 457), the blade of the saw being turned horizontally; care should be taken not to remove more bone than is absolutely necessary, lest the limb be too much shortened. It not unfrequently happens that carious cavities are found, extending below the level of the section that has been made: when

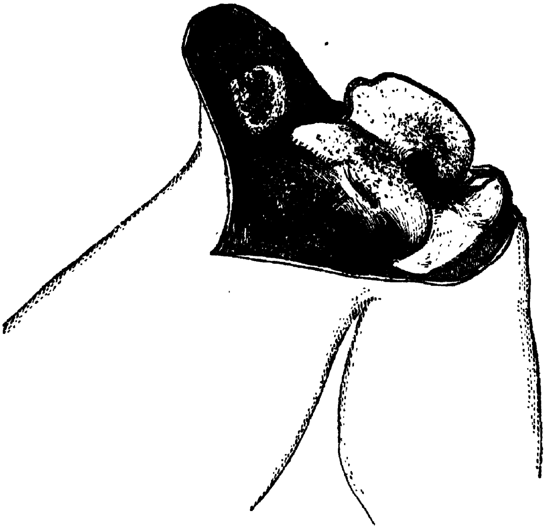


Fig. 456.—Elliptical Incision in Excision of the Knee-joint.

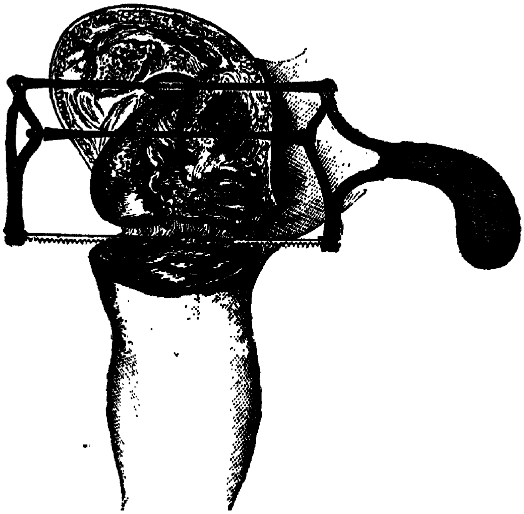


Fig. 457.—Application of Butcher's Saw to Head of Tibia.

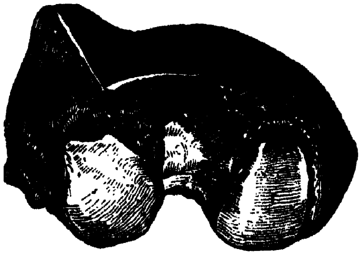


Fig. 458.—Lower End of Femur, excised.

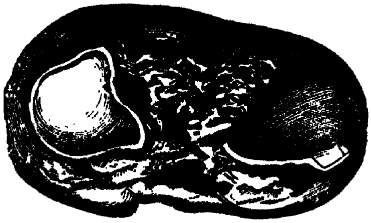


Fig. 459.—Upper End of Tibia, excised.

this is the case, it is better to apply the gouge to them than to saw the bone below their level. It is usually sufficient to remove from one-third to three-fourths of an inch of the tibia, and about one inch or an inch and a half of the thigh-bone (Figs. 458 and 459). Should, however, the operation be performed for disease of the limb, consequent upon the deformity resulting from badly reduced fractures or dislocations about the knee, as has been done successfully by Humphry of Cambridge, it may be necessary, in order to bring the limb into good position, to remove a wedge-shaped piece from one of the bones.

If the patella be much diseased, it must be removed ; if it be only slightly carious, it may be scraped or gouged out ; and if healthy, in accordance with that principle of conservative surgery by which no sound part is removed, it should be left, becoming consolidated with and strengthening the joint. The anterior articular surface of the thigh-bone, which extends some way up its forepart, may advantageously be sliced off, so as to leave an osseous surface, instead of a cartilaginous one, for the attachment of the patella.

In some cases no ligatures will be required, but usually two or three of the articular arteries furnish sufficient hæmorrhage to require restraint. The patella flap when laid down will often appear inconveniently long and thick ; but it is better not to curtail it, unless the bones have been shortened more than usual, as it will contract and eventually fit well.

I have always found the operation, as it has just been described, easy of performance and good in its results ; but various modifications are adopted by different Surgeons. Thus, some make one straight transverse incision ; others two parallel incisions, one on each side of the patella, or an H-shaped incision, and thus open the articulation from the side. Jones of Jersey, who had great experience in this operation, advised that the skin be dissected up by means of a semilunar incision, and then that the ligamentum patellæ be preserved by being pushed with the patella and the quadriceps extensor tendon to one side, the joint then opened, and the bones sawn. Others advise that the patella be removed ; and Holt has recommended that, after the excision, the soft parts of the ham be perforated to allow the discharges to drain through.

The result of the operation will mainly depend on the care taken in the after-treatment. After the operation, the limb should be at once put up securely in a Liston's splint, and well supported. Subsequently, when granulations spring up, it may most conveniently be placed in a long leather trough, extending from *beyond* the foot to the pelvis, and well padded ; particular attention being paid to the position of the limb, and especially to the prevention of any bowing outwards which is apt to take place. In order to prevent displacement, it has been proposed to divide the hamstring tendons ; this, however, I have never found necessary, nor does it seem to me to be advisable to complicate the operation by such an addition to it. The protuberance of the flap, if at all excessive, may be diminished by the pressure of a many-tailed bandage. In this way osseous ankylosis will ensue, and a good and useful straight limb result. In two cases I have succeeded in getting a good limb with a partially movable joint ; both these cases were in children ; and I am disposed to think that in young patients this result may often be satisfactorily attained. In adults, however, osseous ankylosis should always be aimed at. Amongst the various contrivances that have at different times been adopted for the treatment of diseases of the knee-joint, before or after excisions, there is none that appears to be so simple and yet so ingenious as that constructed by H. O. Thomas, as represented in Figs. 460 and 461. This apparatus keeps the limb totally at rest, whilst it enables the patient to move about, as in Fig. 461. In walking, the weight of the body is borne by the two iron rods, about three inches longer than the limb, passing from the padded ring at the groin to the ground, and a patten is worn on the boot of the sound side, so as to equalize the length of the two limbs. Between the two iron rods is a piece of soft leather against which the limb lies, supported in its position by a few turns of a flannel bandage.

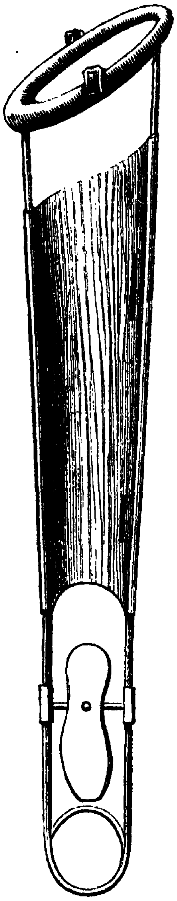


Fig. 460.—Thomas's Knee-Splint.

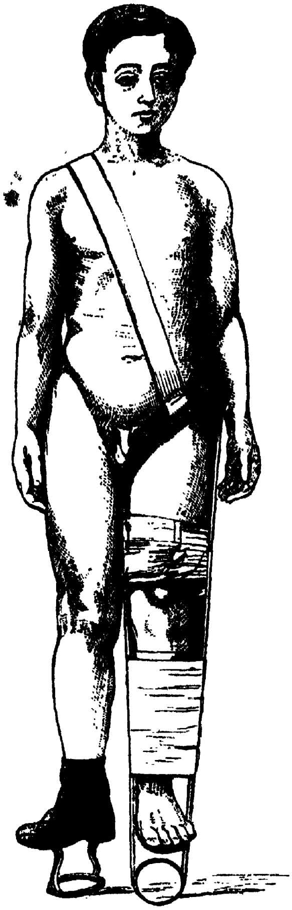


Fig. 461.—Thomas's Knee-splint applied.

**Results.**—In determining the propriety of performing this operation, there are two points to be considered:—1. The Danger attending it; and 2. The Utility of the Limb left after the Operation.

1. In estimating the *Danger* of excision of the knee-joint, we must compare the results of this operation with those of amputation of the thigh, as a substitute for which it is performed. No Surgeon would think of excising a knee-joint that could be saved by ordinary medical treatment, but would only have

recourse to the removal of the diseased articulation in those cases in which its condition did not admit of cure, and would consequently necessitate operation. It is, therefore, useless to institute a comparison between the results of excision of the knee-joint and those of treatment for curable affections of that articulation; but we must compare them with those of amputation of the thigh for incurable disorganisation of the joint.

In 1857, according to Butcher, excision of the knee-joint had been performed 82 times since its revival in 1850. Of these cases 15 proved fatal, and in 8 amputation of the thigh was required, of which 1 case had a fatal issue. In some instances there is reason to believe that the unsuccessful result was owing to want of due attention to the after-treatment of the case. Price has collected the particulars of 160 cases of excision of the knee performed up to December, 1858: of these, 32 were fatal—8 from pyæmia; and to these must be added 60 cases collected by Clarke of Bristol, of which 6 died—1 from pyæmia; in all 220 cases with 38 deaths.

Penières, writing in 1869, gives the statistics of 600 cases in which excision of the knee had been performed. Of 431 cases operated on for disease, 300 recovered and 131 died—a mortality of 30 per cent. The result of excision for gunshot injury has already been alluded to at p. 235, Vol. I., as generally unsatisfactory.

On comparing the mortality after amputation of the thigh with that following excision of the knee-joint, some statistics show no very material difference in the rate of mortality after the two operations. In 1869, Swain found that, in 472 cases of excision of the knee-joint collected by Price, Mac Cormac, and himself, there were 116 deaths, or 24·5 per cent.; while in 54 amputations of the thigh there were 13 deaths, or 24 per cent. Other recent statistics, again, show decidedly in favour of excision. Willett has collected the cases that occurred at St. Bartholomew's Hospital during a period of six years. He finds that of 38 cases of excision 8 proved fatal; whilst of 84 cases of amputation of the thigh for disease no fewer than 37 died—showing a preponderance in favour of excision over amputation in the ratio of 21 against 44 per cent. of deaths. Bryant, however, says that the mortality after the two operations varies much according to age. Thus, among patients under 20 years of age, in 69 amputations of the thigh for disease of the knee, 3 only died, while of 97 cases of excision, 27 died; in 119 amputations between the ages of 20 and 40, 38 died, while of 74 excisions, 39 died. He hence concludes that during the earlier period of life excision is a far more fatal operation than amputation; whilst at more advanced ages, though still more fatal, the balance in favour of amputation is less striking.

2. The second point that has to be determined, is as to the *Utility of the Limb* after the Operation.

On this point, the result of recorded cases is in favour of the operation. In one of Park's cases, operated on in 1783, that Surgeon states that the patient (a sailor), seven years after the operation, "was able to go aloft with considerable agility, and to perform all the duties of a seaman." In some of the latter cases the result has been equally good. One of Jones's patients (a boy) "could run and walk quickly without any aid of a stick, could stand on the limb alone, and pirouetted and hopped two or three yards without putting the sound limb to the ground." In several of my own cases an excellent strong and straight limb has been left, useful for all ordinary purposes. In a case which I examined seven years after the operation, the limb was well nourished, straight, firmly ankylosed, and but very little shortened. The patient, a lad of twenty, could walk eight or ten miles, and even jump and stand on the operated limb without the least pain, sign of weakness, or difficulty. In very young children the result of the operation is not satisfactory, the leg continuing shortened and wasted, not developing with the rest of the body. This is apparently due to and dependent upon the removal of the epiphysis of the tibia, on the integrity of which the growth of the limb is dependent.

After the operation, osseous ankylosis takes place with a firm cicatrix ; the limb is shortened from one to three inches, according to the amount of bone removed, but by means of a high-heeled shoe this inconvenience is greatly remedied. It has been urged against excision of the knee-joint, that convalescence is tedious and prolonged ; but this argument can with justice have but little weight. If an useful limb can be preserved to the patient, it can matter but little if a few additional weeks be devoted to the procedure by which it is obtained ; and, indeed, it is a question whether in many cases the patient may not be able to walk just as soon after the excision of the knee-joint as after amputation of the thigh : for, as has been very properly remarked, though the amputation-wound may be healed in three or four weeks, it may be as many months before an artificial limb can be worn.

On the whole I think it may be fairly said that, although excision of the knee-joint may in some cases leave an excellent result, and thus be preferable to amputation, yet, when we consider the uncertainty of this result, the greater mortality attendant on excision than on amputation of the thigh for chronic disease of the knee-joint, especially in the two earlier decennial periods of life, we should practise excision as the exceptional operation, and I would still feel disposed to give the preference to amputation in the majority of cases. In addition to these considerations, there is an additional element which cannot altogether be discarded in enabling us to form a judgment as to the preferable operation. And it is this, that, in consequence of recent improvements in surgical mechanics, artificial limbs are now constructed of so durable and useful a character, as to supply to a great extent the loss sustained by amputation, and this more particularly if the limb have been removed early in life, when the patient can more readily adapt himself to new methods of progression.

BONES OF THE LEG.—The **Tibia** is very frequently the seat of caries in the upper and lower epiphyses, and of necrosis in the shaft, requiring partial operation for the removal of the diseased portions. Occasionally a very considerable extent of the shaft, indeed the whole of it, may be removed in a state of necrosis, as a loosened sequestrum, from the interior of the periosteum, more or less consolidated and strengthened by the deposit of new bone. Such operations present nothing special, and the result is usually very satisfactory, the limb that is left being strong, useful, and sound.

The **Fibula** is less frequently the seat of operation, but it, like the tibia, may require partial removal. In one case, that of a child six years of age, I successfully removed the whole of the necrosed fibula. This operation is readily done by slitting up the sinuses in a direction so as to expose the sequestrum, which may be then drawn out without difficulty (Figs. 462 and 463). After the operation an inner splint must be applied, in order to obviate the tendency to varus which will ensue. In the case from which the annexed drawings are taken, very considerable reparative action was set up in the periosteum and soft tissues along the line of bone that had been removed, new osseous matters apparently being deposited; and the child, when examined two years after the operation, had an excellent, well-nourished, and useful limb. The foot, however, had a tendency to be drawn inwards, apparently owing to the flexors having overcome the antagonism of the peroneal extensors. This deviation inwards was counteracted by the patient wearing a properly constructed boot, with which walking was perfectly easy.

FOOT.—In looking at the division of the foot into its three great component parts—toes, metatarsus, and tarsus,—we shall perceive that firmness of gait is given by the foot resting on the heel behind, and on the ball in front formed by the projection of the broad line of the metatarso-phalangeal articulations, more particularly that of the great toe; whilst elasticity is communicated to the tread by the play of the toes and metatarsal bones. The elasticity of the foot may be lost without any very serious inconvenience to the patient; but the preservation of stability and firmness of gait are of essential importance; and as these are secured by the heel, the ball of the great toe, and the breadth of the anterior part of the foot, these are the most important parts to preserve in all resections of this part of the body.

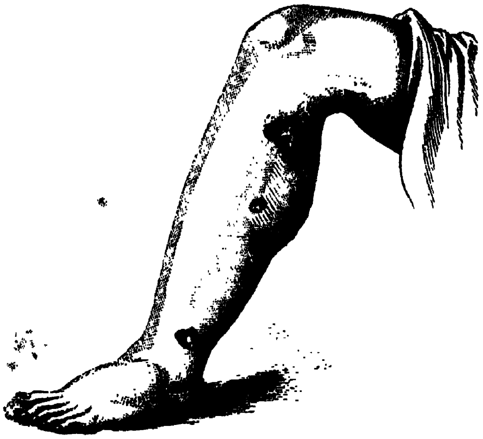


Fig. 462.—Limb with Necrosis of Fibula.

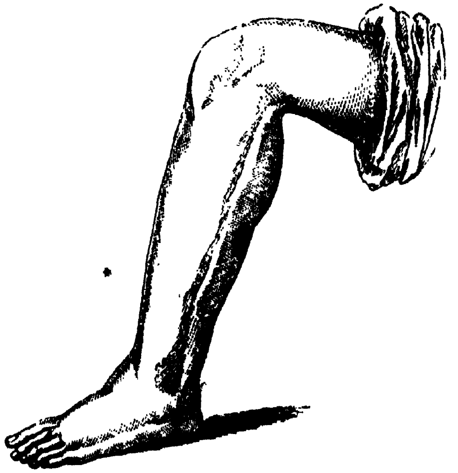


Fig. 463.—Limb after Removal of Fibula.

In no region of the body have the good effects of modern conservative surgery been more distinctly shown than in the Tarsus. In the "good old times" of Surgery, if a person had a "white swelling" of the bones of the foot, or a diseased tarsus, he was at once condemned to amputation of the limb. No distinction was drawn between disease of the different parts of the foot, nor any attempt made to save the sound by the sacrifice of the diseased part.

Until a comparatively recent period, indeed, "diseased tarsus" was described as a whole. Surgeons did not endeavour to make out the exact extent and amount of the disease, and any case described as "diseased tarsus" was looked upon as requiring amputation of the leg. The rule of practice then observed was, amongst the wealthier classes—those who could afford the expense of a "cork leg"—to amputate a little above the ankle; but, amongst the poorer classes, to remove the leg about a couple of inches below the knee, so as to give the patient a stump which, when bent, would fit into the socket of a wooden pin. Thus, in the latter case especially, not only was the leg, itself perfectly sound, sacrificed, but the patient was exposed to great additional danger; for if there be one point more than another which has been indisputably proved by surgical statistics, it is, that the mortality after amputation increases, *cæteris paribus,* in exact proportion as we approach the trunk—every additional inch which we remove augmenting the danger to the patient. This practice continued to prevail until Chopart drew some distinctions between the treatment to be pursued, according as the disease affected the anterior or the posterior tarsal bones and articulations. He showed that, when the anterior articulations only were affected, amputation at the junction of the astragalus and calcaneum with the scaphoid and cuboid—an operation which goes by the name of "Chopart's amputation"—ought to be performed; thus removing the whole of the disease, and allowing the patient to recover with a shortened foot, with the heel preserved—one on which he could bear the weight of his body, and which would be highly useful to him.

The next step in the conservative surgery of the lower extremity, in cases of diseased foot, was the operation introduced by Syme—that of disarticulation at the ankle-joint. This was certainly a great advance; for, the flap being taken from the heel, the patient has a stump on which he can bear. The operation is also a very safe one. According to O. Weber, 17 deaths only have occurred in 101 cases of this operation. I have performed it many times without a death, and this, in the lower extremity, is extremely satisfactory.

Since the introduction of anæsthetic agents, Conservative Surgery has taken great strides; and I think Conservatism in Surgery may be regarded as the necessary result of Anæsthesia. For, although operations of this kind were performed years ago by Park, the Moreaus, and others, and their utility demonstrated, yet the operations of gouging, scraping, and partial resection were so horribly painful to the patient, and occupied so much time in their performance, that patients dreaded to submit to, and Surgeons declined to undertake, them. Of late years Surgeons have learned to discriminate disease of one part of the tarsus from that of another, and to apply appropriate treatment to each.

Looking at the subject in a diagnostic point of view—and the treatment is most intimately connected with minute and accurate diagnosis—we find that the pathology of diseases of the tarsus is closely connected with its healthy anatomy. Composed of seven bones, it presents four distinct articulations. By the term "articulation," applied to the tarsus, I do not mean merely the connection of contiguous bones with each other, but distinct synovial sacs shut off from communication with other synovial sacs in the foot. These are well represented in the annexed diagram (Fig. 464). The *posterior calcaneo-astragaloid* is the first of them; next comes the (*a*) *anterior calcaneo-astragaloid,* the synovial membrane here serving also for the *astragalo-scaphoid;* the *calcaneo-*

*cuboid* (*b*) is the third; and the *anterior tarsal synovial membrane* (*c*) is the fourth and largest of all, and the most important in a surgical aspect. It extends between the scaphoid and the three cuneiform and the cuboid bones, between the cuneiform bones themselves, between the two outer cuneiforms and the bases of the second and third metatarsal bones, and also between the external cuneiform and the cuboid. The articulation between the cuboid and last two metatarsal bones is shown at *d*; and *e* is that between the internal cuneiform and the first metatarsal bones. These two (*d* and *e*) are not, strictly speaking, tarsal joints.

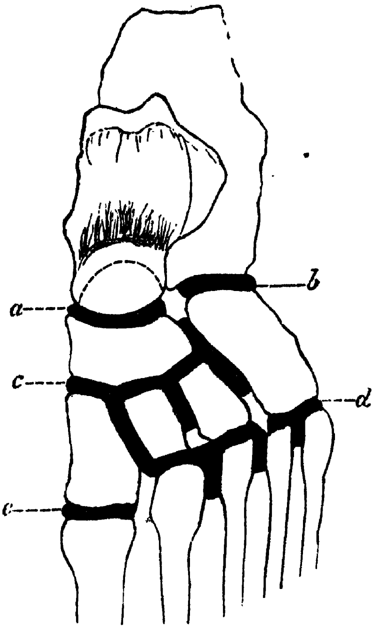


Fig. 464.—Diagram of Synovial Membranes of the Foot.

In the vast majority of cases, so far as my experience goes, it is the osseous structures, and not the articulations, which are primarily diseased. The bones, being cancellous, far removed from the centre of circulation, and exposed to alternations of temperature, readily become the seat of congestion and caries, but rarely of necrosis; and in strumous subjects not unfrequently fall into a tuberculous condition. Caries, whether simple or tuberculous, once set up in bones, speedily implicates the articulations secondarily.

Now it will easily be understood, on casting an eye on the arrangement of the tarsal synovial membranes, that the extent of disease will, in a great measure, depend upon its original seat. Thus, a person may have disease in the os calcis, extending even to the cuboid, with very little likelihood of its proceeding farther for a length of time. Such disease is limited to the outer part of the foot, does not involve its integrity, and readily admits of removal by operation. But let him have disease springing up in the scaphoid, or in one of the cuneiform bones, or in the bases of the second or third metatarsal bones, and the morbid action will rapidly spread through the whole of the anterior and inner part of the tarsus, and, in all probability, no operation of resection can be advantageously employed. Hence the seat of disease influences materially its amount and extent, and the kind of operation required.

The foot is frequently the seat of strumous disease; to this it is disposed by the alternations of temperature to which it is subjected, by its liability to sprains and injuries, and by the cancellous and spongy structure of its bones, together with its extensive articulating surfaces. When affected by strumous inflammation it becomes painful, the patient being unable to bear upon the toes or anterior ball of the foot. Swelling of an uniform character takes place, with tenderness at some point opposite the bones or articulations that are chiefly involved; and eventually abscess forms, leaving sinuses through which the probe passes down upon softened and carious bone. These evidences of disease are usually much marked about the dorsum and sides, the sole being often comparatively free—an important point in reference to operation.

Strumous disease may commence either in the bones, or in the articulations of the foot. The bones that are most frequently the seat of primary disease are the calcaneum, the astragalus, the scaphoid, the cuboid, and the metatarsal bone of the great toe. When disease is limited to one or two of these bones, excision is usually practicable; but when the morbid action extends, through the influence of the connecting articulations, to other bones of the tarsus or metatarsus, partial amputation will probably be required.

Primary disease of the articulations of the foot is a less frequent cause of operation than caries of the tarsal bones leading secondarily to an implication of the contiguous articulations; and the particular operation required will, in a great measure, depend upon the extent of implication of the synovial membranes of the foot. When the calcaneo-astragaloid or the calcaneo-cuboid articulations are alone affected, with their contiguous bones, resection of the bones and joints implicated will often be attended by very satisfactory results; but when the large anterior tarsal synovial membrane is in a state of chronic disease, either as the result of primary morbid action set up in it, or secondarily to diseases of the scaphoid, the cuneiform, or of either of the metatarsal bones connected with it, then resection is scarcely admissible, and Chopart's amputation offers the best means of relief. The inflammation of the large and complicated anterior tarsal synovial membrane commonly commences in disease of the scaphoid. It may, usually, readily enough be recognised in its earlier stages by the pain and swelling that take place across the line of articulation between the scaphoid and cuneiform bones, the pain being greatly increased by bending the foot down, and extending across the whole breadth of the foot. For, although it is usually most severe at the inner side, which is the first affected, yet the external section of this complicated articulation, that between the external cuneiform and the cuboid, becoming involved, causes suffering to be experienced on the outer side of the foot as well. In the more advanced stages of this particular disease, the foot assumes a remarkable bulbous or clubbed appearance; the symmetry of the heel and the outline of the ankle are unimpaired, but the forepart and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus. I look upon this disease of the anterior tarsal synovial membrane as a distinct affection of the foot, requiring to be diagnosed from the other strumous inflammations, and in its advanced stages demanding Chopart's amputation.

It may be stated generally that the result of disease of the tarsus will be mainly dependent upon whether it is acute or chronic, progressive or stationary, diffused or limited. When it is *acute*, its limit cannot be defined, and after the removal of one portion the morbid action may be lighted up afresh in the structures, osseous or articular, that have been left. When *progressive*, there will be found to be a general tendency to disease in, or disorganisation of, the tarsal structures, and partial operation can be productive of little good. When it is *diffused*, extending into the large anterior tarsal or tarso-metatarsal articulations, partial operation can avail nothing. In is in those cases in which the disease is *chronic*, *limited*, and *stationary*, or nearly so, that excision and partial operation can be beneficial.

**Excision of Tarsal Bones.**—Any one of the tarsal bones may be the seat of primary disease, which may be limited to the bone originally implicated, or may extend to neighbouring articulations, or through the whole tarsus. There are, however, four bones which may be looked upon as the most frequent centres of tarsal disease—viz., the Os Calcis, the Astragalus, the Scaphoid, and Cuboid; and they are commonly affected in the order given.

The **Os Calcis,** from its exposed situation, large size, and spongy structure, is more frequently the seat of caries and necrosis than any of the other tarsal bones. Very commonly the disease is limited to this bone; in other instances it extends into the calcaneo-astragaloid or calcaneo-cuboid articulations.

When the disease is situated in the *posterior* or *lateral part of the bone,* the neighbouring articulations are seldom involved, and then the removal of the morbid structures by gouging will usually succeed in effecting a cure. I have frequently had occasion in this way to scoop out great portions, sometimes the whole of the interior of the calcaneum, with the most excellent results. Even when the cuboid is extensively implicated as well, and the calcaneo-cuboid articulation is the seat of diseased action, the disorganised structures may often be removed by gouging and partial resection, as in the case of which the cut (Fig. 465) is a good representation, where, by means of a ⊥-shaped incision, these bones were exposed, and their carious portions gouged out. Should, however, the caries have affected the *superior* or *anterior portions of the bone,* then the implication of the astragaloid or cuboid articulations may render the excision of the whole bone necessary, as the only means of preventing extension of secondary morbid action to the tarsus generally. So unfrequent, however, is disease of the articular aspects of this bone, that its complete removal is very seldom necessary. Out of at least fifty cases of caries of the os calcis that have been under my care, I have only had occasion to excise the whole bone once; and Fergusson states that he has never yet found it necessary to do this operation. Indeed, excision of the os calcis should not be lightly undertaken. The large size of the bone, its importance as a basis of support to the body, and as the point of attachment to the strong muscles of the calf, should induce the Surgeon, whenever practicable, to avoid its complete extirpation, and to limit himself to the application of the gouge, even though he may have to scoop out the whole of the interior of the bone, leaving little more than an osseous shell. This will fill up by the deposit of a dense fibroid tissue, which probably, eventually undergoing partial ossification, leaves the foot as useful as ever for all purposes of support and progression.

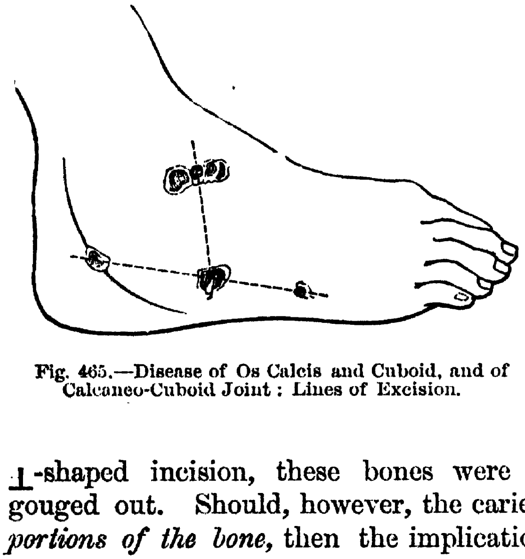


Fig. 465.—Disease of Os Calcis and Cuboid, and of Calcaneo-Cuboid Joint: Lines of Excision.

**Operation.**—Excision of the os calcis is usually performed by turning a heel-flap back, as in disarticulations at the ankle-joint, and then carrying incisions forward into the sole of the foot, by which another flap is turned up, and the calcaneo-cuboid articulation exposed and opened (Fig. 466); after which the knife is carried between the astragalus and calcaneum, and the latter bone detached. By this operation the sole of the foot is somewhat extensively incised, and cicatrices are left over the heel.

In order to avoid this inconvenience, I have found that disarticulation of the os calcis may readily be performed in the following way. The patient lying on his face, a horseshoe incision is carried from a little in front of the calcaneo-cuboid articulation round the heel, along the sides of the foot, to a corresponding point on the opposite side. The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under surface of the os calcis thus exposed. A perpendicular incision, about two inches in length, is then made behind the heel, through the tendo Achillis, in the mid-line and into the horizontal one. The tendon is then detached from its insertion and the two lateral flaps are dissected up, the knife being kept close to the bones, from which the soft parts are well cleared (Fig. 466). The blade is then carried over the upper and posterior part of the os calcis, the articulation is opened, the interosseous ligaments are divided, and then, by a few touches with the point, the bone is detached from its connections with the cuboid. This bone, together with the astragalus, must then be examined; and if any disease be met with, the gouge should be applied. Should ankylosis have taken place between the os calcis and the astragalus, as I have found in one case, the bones

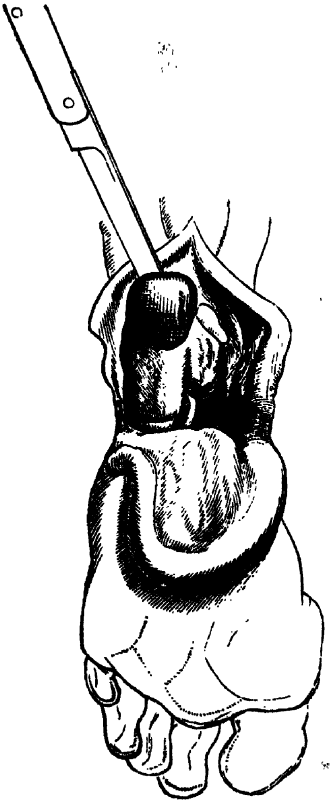


Fig. 466.—Excision of the Os Calcis.

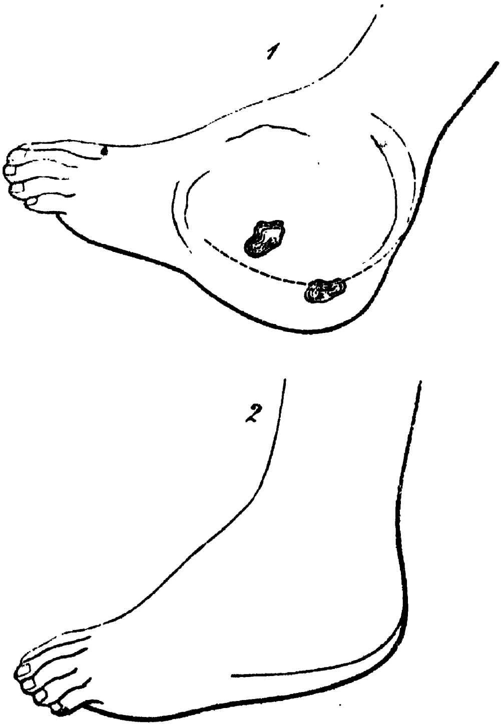


Fig. 467.—Disease of the Os Calcis.
1. Foot before Operation: 2. Foot after Excision.

may readily be divided by means of Butcher's saw. By this operation all injury to the sole is avoided; and the open angle of the wound being the most dependent, a ready outlet is afforded for the discharges.

The drawing (Fig. 467) gives an excellent representation of the state of the foot of a girl before and after the excision of a diseased os calcis—a somewhat flattened but most useful foot resulting.

**Subperiosteal Excision.**—Ollier has described a mode of removing the os calcis, in such a way that the periosteum may be preserved so as to allow the regeneration of the bone. A curved incision, commencing on the outside of the tendo Achillis, at the level of the ankle-joint, is carried down as far as the external tuberosity of the os calcis, and thence along the side of the foot as far as the posterior end of the fifth metatarsal bone. The flaps being raised, the periosteum and tendo Achillis are separated from the bone, which is then further denuded of its periosteum as far as can be reached: the ligamentous attachments are divided, and the bone is removed. In fact, in caries of the os calcis, it may often be found, as in performing Syme's amputation, that the thickened periosteum strips off the softened and carious bone as readily as the peel off an orange; hence a formal process of dissection is scarcely needed.

*History and Results.*—Excision of the os calcis is a very successful operation. It seems to have been first performed by Monteggia in 1813; the result appeared promising, when the patient died of scrofulous disease. The operation then fell into abeyance for twenty-four years, when Robert, in 1837, in a case of necrosis of the bone, removed the diseased portion, leaving the healthy peripheral layer. The same Surgeon, in 1844, in a case of caries, removed the whole bone with the exception of its upper articular surface and the inner side of the body. Greenhow of Newcastle, in this country, and Rigaud, in France, appear to have been the first Surgeons who successfully excised the whole of the os calcis. Their cases both occurred in 1848; and since that time the operation has been performed in a large number of cases in this country and in America, and established as one of the many important developments made by Conservative Surgery in late years. In France, it seems to have met with little favour, though it has been successfully performed there in several instances by Ollier, Giraldès, and some other Surgeons. Guérin says that the operation should not be attempted: and gives as his only reason for describing the operative procedure, that English Surgeons have not feared to undertake it.

Polaillon, of Paris, in an able article written in 1869, with the object of advocating the performance of the operation, has collected the records of 64 cases. Of these he sets aside 9, of which he has not been able to find sufficiently accurate statements as to the result. Of the remaining 55, 39 were successful—this term implying that the patients were enabled afterwards to walk without artificial apparatus or support. Of the remaining 16, in 6, crutches or other apparatus were necessary; in 7, subsequent amputation was demanded on account of return of the disease or inutility of the foot; and there were 3 deaths. Resection of the entire bone—in a few cases with other portions of the tarsus—appears to have been performed in 39 of the 55 cases; of these, 30 were altogether successful; in 4, artificial support was necessary; 2 required subsequent amputation; and 3 died. The operation, according to Polaillon, has been more successful in children than in adults. He states that, of 12 cases under 10 years old, all were successful; between the ages of 10 and 20, there were 14 successful cases, and 3 failures; between 20 and 30, 7 successes and 9 failures; and between 30 and 40, 6 successful cases and 3 failures. Reproduction of the bone occurred in 12 cases; 11 being in individuals under 20 years of age.

The **Astragalus** is situated in a position of great surgical importance. Articulating with the malleolar arch above, with the calcaneum below, and with the scaphoid in front—forming, as it were, the keystone of the foot—it is perfectly evident that any morbid action commencing in it is very likely to spread to and involve all the more important structures of the foot. Seldom, indeed, does disease originating in this bone long remain confined to it; and, so far as my experience goes, gouging operations, even if performed at an early period, are rarely of much benefit, the morbid action continuing to extend notwithstanding their employment. Indeed, in diseased astragalus, I believe that excision ought, as a rule, to be practised in preference to gouging, contrary to what is the case in the calcaneum.

Disease primarily originating in the astragalus may spread in three directions: upwards into the ankle-joint, downwards to the calcaneum, and forwards to the scaphoid, and thence through the large anterior synovial membrane to the rest of the tarsal bones. The treatment will vary according to the direction and extent of the disease. It may be arranged under four heads.

1. When the *astragalus alone is diseased*, we find what is seen in the drawing (Fig. 468), which represents the foot of a boy whose astragalus I excised—swelling just in front of the malleolar arch, with fistulous openings leading down to the diseased astragalus; the anterior part of the foot and the heel being quite sound. If the morbid action be limited to the outer side of the bone, or to its head, it is possible that, by freely opening up the sinuses and applying the gouge, the caries may be entirely removed. But this operation is not so satisfactory here as elsewhere in the foot, as it is by no means easy to avoid opening the astragalo-scaphoid articulation; and if this be done, disease will almost inevitably extend through the tarsal articulations. Excision of the astragalus alone, though sometimes required for disease, is perhaps more frequently called for in those cases of compound dislocation in which the bone, having been thrown out of its bed, eventually becomes carious or necroses.

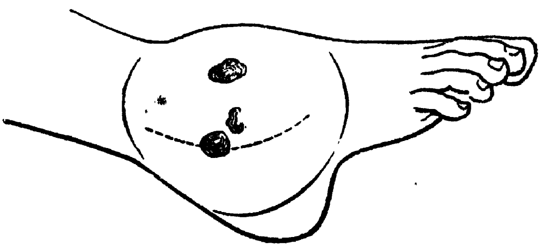


Fig. 468.—Disease of Astragalus.

The operation of excision of the whole of the astragalus for disease may be done as follows. A curved incision, from four to six inches in length, should be made immediately behind the outer malleolus, and carried forward on the outer part of the dorsum of the foot to opposite the fore part of the bone. The divisions of the external lateral ligament of the ankle-joint are then cut across; the tendons of the peroneus brevis and tertius, and the extensor brevis digitorum muscle, divided. But the mass of extensor tendons in front of the foot, with the dorsalis pedis artery, must be left untouched. These should be drawn forcibly inwards. The peroneus longus tendon may be drawn backwards. The foot is then strongly twisted inwards, the astragalus cleared, and its ligaments divided from the outer side in succession as they present themselves. When the operation is done for disease of the bone, these structures will usually be more or less softened and disorganised; when for injury, they will in a great measure have been torn through. Hence, in actual operation, the same steps cannot be followed so methodically as may be done on the dead subject. The bone must now be seized with lion-forceps and drawn well out of its bed; the knife being applied to any restraining structures, but being used very carefully towards the inner side of the bone, lest the plantar arteries be wounded. Under this process the softened and carious bone usually breaks down and has to be taken away piecemeal, or its neck may be cut across, and the head separately removed from its articulation with the scaphoid. If the bone have been dislocated, and its ligamentous connections thus torn through, or if these have been disorganised and softened by disease, it may readily enough be removed as just described. But if the osseous tissue itself be carious and softened, and the ligamentous connections tolerably sound, then the operation becomes extremely troublesome, tedious, and prolonged—the bone breaking down, and having to be removed piecemeal by means of the gouge and pliers.

The *result* of this operation is very satisfactory; a good and movable articulation may be left between the malleoli and calcaneum, and the limb is but little shortened. According to Hancock, of 109 cases in which the astragalus was removed, 76 recovered with good and useful limbs; secondary amputation was performed in two, with one death; 15 others died; and in 14 the results are not known. The operation was performed in 64 cases for compound dislocation, with 50 complete recoveries; in 20 of simple dislocation, with 14 complete recoveries; and in 10 for caries, perfect recovery taking place in 6.

2. When the disease has *extended from the astragalus to the malleolar arch, excision of the ankle-joint* will be required. This operation may most conveniently be performed in the following way. A semilunar incision, about four inches in length, should be made along the outer and inferior aspect of the joint, round the lower border of the external malleolus (Fig. 468), and should be carried sufficiently forwards to give space without dividing the extensor tendons or the dorsal artery. A perpendicular cut should then be made along the back of the fibula. The peroneal tendons need not be divided, but should be drawn downwards and backwards; the lower end of the fibula should next be cut across and detached. The astragalus, which will now be exposed, should then be separated from its connections, which, if they be much diseased, may usually be readily done. If not deeply affected, it will be more firmly held, and should then be cut across with pliers, and each fragment lifted out of its bed with gouge or pliers. The foot may next be well drawn to the inner side, and the lower end of the tibia carefully isolated; the knife being used with great caution, and kept close to the bone, lest the posterior tibial artery be

injured. When the ligamentous structures attached to the bone have been separated, the inner malleolus is cut off with bone-forceps, and as much as necessary of the lower end of the tibia removed by a gouge or chain-saw.

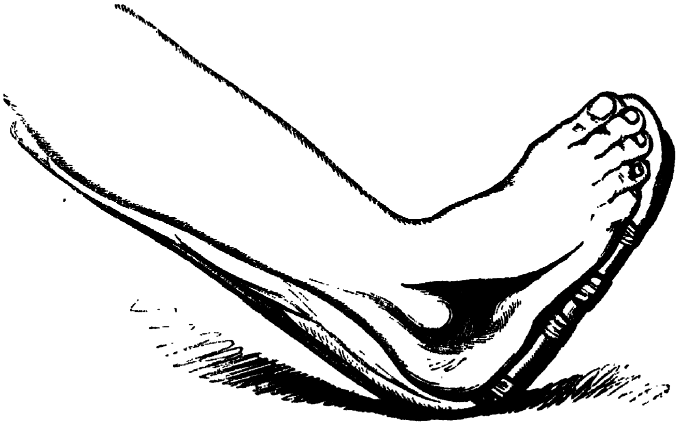


Fig. 469.—Limb after Excision of the Ankle-joint.

Should there be any disease of the articular surfaces of the calcaneum or scaphoid, this must be gouged away. The part should then be lightly dressed, and the limb placed on a Liston's splint.

3. When the disease has *extended from the astragalus upwards into the malleolar arch, and downwards into the calcaneum,* the line of practice will depend on the extent of the implication of the os calcis. If the greater part or the whole of this be involved, no resource is left but amputation—resection not leaving a useful foot. If, however, the calcaneum be only partly involved, its upper surface only being affected, a great deal may be done by conservative surgery. The treatment in such cases consists, generally, in removing the astragalus from its bed, and gouging away any diseased bone which may exist either on the upper surface of the calcaneum or on the under surface of the malleolar arch. Very large portions of bone may be removed from this situation. I have taken away the whole of the malleolar arch and astragalus, and gouged out the upper surface of the os calcis very freely; and yet the patient has recovered with a strong and movable foot, but very little shortened or deformed.

The accompanying cuts (Fig. 470) are taken from a young man on whom I performed the operation just described. The foot is perfectly useful and strong, and the false joint at the ankle movable. There are cases, however, in which we find that the disease has extended so far beyond its primary seat, that amputation rather than resection is required.* But, in the majority of instances, removal of the astragalus and gouging away the upper surface of the calcaneum will suffice.

The *result* of excision of the tibio-tarsal articulation is generally good. Spillman says that of 73 cases 50 were successful. Among these, the outer malleolus was removed in 22, one of which required secondary amputation, and 4 died. This leaves 51 cases of removal of the tibio-tarsal joint; in 12 of these, the disease was of traumatic origin, and the operation was successful in 11; in 37 it was constitutional, and of these 22 recovered, 7 died, 7 required secondary amputation, and in one the disease continued two years after the operation.

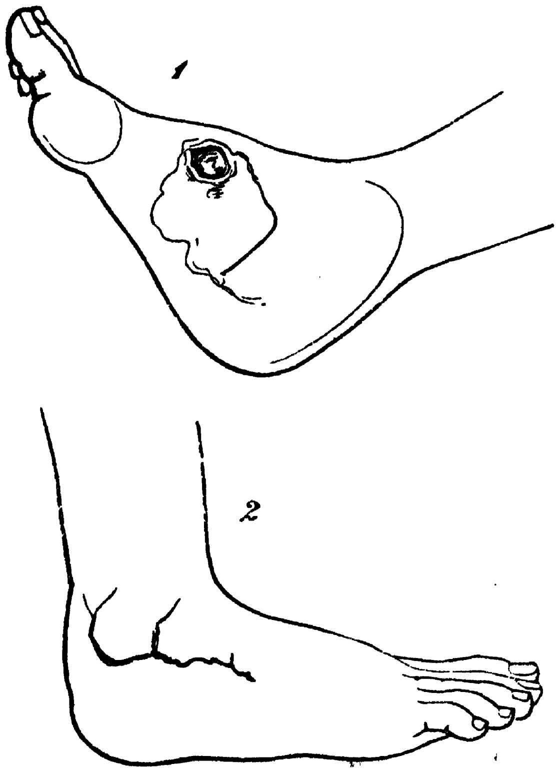


Fig. 470.—Excision of Astragalus. 1. Foot before Operation. 2. Foot six months after the Removal of the Malleolar Arch, both Malleoli, the Astragalus, and a portion of the Upper Surface of the Calcaneum.

4. If the disease have *extended from the astragalus to the scaphoid,* and thence *into the anterior range of tarsal joints,* the foot will have become so extensively disorganised, that partial resection will be of little or no service; and disarticulation at the ankle-joint should be practised.

Excision of the **Cuboid Bone,** either in whole or in part, may be required. Partial excision is here done with the gouge. When the whole of the bone is taken away, the fifth metatarsal bone with the little toe will probably also require removal. This may be done by making the flap, as depicted in Fig. 41, vol. I., only commencing the incision about an inch further back, opposite the calcaneo-cuboid articulation, and opening this instead of the metatarso-cuboid.

The **Scaphoid Bone** is very commonly the seat of primary disease; and, as this bone is connected in front with the large tarsal synovial membrane, and posteriorly with that which is common to the calcaneo-astragaloid and astragalo-scaphoid articulations, the greater part of the tarsus is apt to become speedily involved in the morbid action. It stands, indeed, next to the astragalus in its power of implicating a great extent of the foot when diseased. The extent of this implication is such, that excision of the primarily diseased bone would probably seldom be attended by much benefit, and Chopart's amputation or disarticulation at the ankle-joint becomes necessary. Next to disease of the astragalus, I look upon strumous inflammation and caries of the scaphoid as most destructive to the integrity of the foot.

When the **Cuneiform Bones** are the seat of caries, it will generally be found that the middle cuneiform is the bone primarily affected. Thence the disease extends to the lateral ones, or to the bases of the second and third metatarsal bones (Fig. 471). In such cases the anterior tarsal synovial membrane usually becomes extensively implicated, and Chopart's amputation will be required. But if the morbid action continue to be limited to the middle cuneiform and the contiguous metatarsal bones, and the patient's general health be good, removal of the diseased osseous structures by the gouge, with extraction of the carious cuneiform, may be attended by successful results.

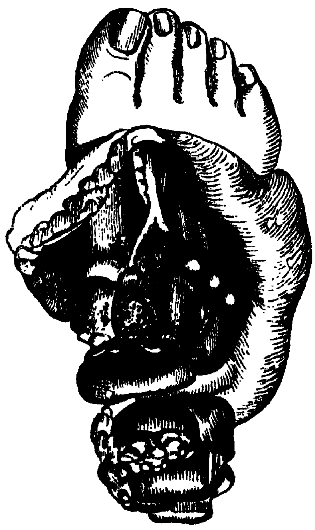


Fig. 471.—Disease of Cuneiform Bones.

**Excision of more than one of the Tarsal Bones** is sometimes required in chronic disease, and may leave an excellent and useful limb. No formal rules for the operation can be laid down; the course of proceeding must depend on the nature of the case and the judgment of the Surgeon. In a lad who was many years since under my care with very extensive and chronic disease of these parts, I removed the lower three inches of the fibula, and gouged away considerable portions of the end of the tibia and of the astragalus, calcaneum, and cuboid—removing a whole handful of carious bone; yet a perfect cure resulted, the patient recovering with a strong and useful foot. The os calcis and astragalus have been both successfully removed by T. Wakley in 1848, and by Watson of Edinburgh; and the os calcis, almost the whole astragalus, and a part of the scaphoid, by Nicholls of Chelmsford. Mulvany, in a case of disease of the tarsus consequent on compound dislocation, removed the greater part of the scaphoid, half the os calcis, all the astragalus, and the lower end of the tibia. Fayrer removed the articular ends of the tibia and fibula, the os calcis, astragalus, and scaphoid for disease, in a boy 9 years old; and Lehmann of Polzin, in a case of caries in a man aged 40, removed by subperiosteal excision the entire os calcis, the astragalus, and the scaphoid bones, the foot having a perfectly normal appearance three months after the operation, and the patient being able to walk well, without a stick.

In infants and very young children, disease of the tarsal articulations and even bones may often be recovered from, without the necessity of having recourse to operation, by attention to the child's general health, and by giving the part rest.

The **Malleoli** alone seldom require resection. Should either of them do so, the operation may readily enough be accomplished, in the outer malleolus, by dividing the bone with cutting-pliers; but in the inner malleolus, more care is required in avoiding the flexor tendons, the artery, and nerve, and the bone had better be cut across with a chain-saw. The removal of the outer malleolus, or rather of the lower end of the fibula, is apt to be followed by a tendency to twist of the foot outwards—in fact, to a kind of valgus.

The **Metatarsal Bones with their Toes** occasionally require removal. This is more particularly the case with the first and the fifth (p. 77, vol. I.). The middle metatarsal bones cannot advantageously be taken away, leaving merely the first and last; but the two, three, or even the whole four of the external metatarsal bones may be resected in early life, and a useful foot left. Aston Key has recorded a case in which, in consequence of injury, he amputated the four outer metatarsal bones, the cuboid, and the external and middle cuneiform, leaving merely the line of bones supporting the great toe. The first metatarsal bone was left, supported only by the slender articular service of the internal cuneiform; but it soon got firmer attachments, and a very good foot resulted, by which the patient retained in a great measure his elasticity of tread.

The **Phalanges and Articulations of the Toes** seldom require resection; as a general rule, their amputation is preferable. The only case with which I am acquainted in which resection of the phalanx is required, is when an exostosis has formed under the nail of the toe, pushing it up: here the removal of that portion of bone from which it springs is the best course to pursue.

The **Great Toe** not unfrequently requires removal, in whole or in part; but, as it enters largely into the formation of the arch of the foot, no more of it should be taken away than is absolutely necessary. It is especially of importance that the ball of the great toe, if possible, be preserved; and occasionally this may be effected by excision of the metatarso-phalangeal articulation rather than by the amputation of the member. With regard to the removal of the toe and its metatarsal bone, I must refer to p. 77, vol. I. Whenever it is practicable, the proximal end of the bone should be saved, in order that the insertion of the tendon of the peroneus longus may be preserved.

## AMPUTATION IN JOINT-DISEASES.

In those cases in which excision of the diseased joint is not advisable, in consequence of the acute character of the articular disease, the existence not only of considerable suppuration but of great local and constitutional irritation, or the peculiar nature of the joint affected, amputation may be the sole resource left to the Surgeon. It is especially in articular disease of the fingers and toes, of the tarsus, carpus, ankle, and knee, that this operation is required; and though it is much less frequently practised now than formerly, yet the cases of destructive disease of joints requiring amputation are amongst the most frequent in operative surgery, and will doubtless continue to be so. The Surgeon, however, must be careful, whilst he avoids continuing to make ineffectual attempts to save the limb at the great hazard of the patient's life, not to amputate until it is clear that all other means have failed; the patient continuing to lose ground so that a further perseverance in local and constitutional treatment would probably end in his death, excision not being practicable. So far from amputation being an opprobrium to surgery in such cases as these, I look upon it as one of the greatest triumphs of our art, that by a simple and easy operation, which removes the spoiled and useless limb, the life of the patient may be saved, and his health speedily restored.

In amputating in cases of chronic joint-disease, where the limb has been the seat of prolonged suppuration, it will be found, just as in cases of many secondary amputations after injuries, that the condition of the muscles of the limb is peculiar. Instead of, as in cases of primary amputation, being dark in colour and retracting forcibly and unequally when cut across, they will be found to be pale, soft, flabby, and retracting but little, if at all; resembling in this respect the muscles in a dead body, with the intermuscular areolar tissue often infiltrated. In consequence of this alteration in their structure and physiological properties, the flaps need not be cut so long in amputation for chronic suppurative joint-disease as in cases of primary amputation.

**Circumstances influencing Mortality.**—The mortality after amputation for joint-diseases is especially influenced by three conditions: viz., the Seat of the Operation, the Acute or Chronic Character or the Disease, and the Constitutional Condition of the Patient.

The influence of the *seat of operation* has already been discussed at p. 53, vol. I.

The *duration of the disease* exercises a most important influence, especially in the larger joints—more particularly the knee. As a general rule, it may be stated that, the more acute the suppurative destruction of a joint, the less successful is the amputation of the limb likely to be; pyæmia and low secondary inflammation being especially apt to supervene. (See p. 56, vol. I.)

In very acute cases, the Surgeon ought to evacuate the pus by means of free incisions, and endeavour to delay the necessity of amputation until the active suppurative stage has passed, and the affection has subsided into a chronic form. In chronic cases, the success of amputation is very great. It commonly happens that a patient who has been racked with pain, and been wasting in body for weeks before the local source of irritation was removed, sleeps soundly the night after the operation, and rapidly gains flesh and strength.

In determining upon the advisability of resecting a diseased joint or of amputating the limb, the Surgeon must be guided not only by the amount of disease in the articulation, but by the *constitutional condition* of the patient. In amputation the chief dangers are immediate—from shock, or secondary hæmorrhage. In excision the shock is not so severe, in consequence of the incision being farther from the trunk, and through comparatively superficial and unimportant parts; no large blood-vessels, nerves, or even muscles are divided, and there is no danger of secondary hæmorrhage. But in excision the dangers are chiefly remote; the suppurative process is long continued, and the discharge of pus abundant; the patient may consequently not have sufficient constitutional power to carry him through. So far as erysipelas and pyæmia are concerned, the danger is probably the same in both operations. In addition to this, it must be borne in mind that a patient will often consent to have a joint or bone excised who would not agree to part with a limb.

As phthisis not unfrequently co-exists with the advanced forms of strumous joints, the question of amputation under these circumstances becomes one of very considerable importance. If the phthisis be rapidly progressing, and there be a strong hereditary tendency to the disease, or if it have advanced to softening of the lung and the formation of vomica, it will be useless to operate. If, however, the phthisis be but slight and incipient, and be apparently due to the local irritation of and discharge from the diseased joint, to the confinement to bed that this necessitates, and to the general deprivation of health that ensues, amputation may not only be safely but advantageously practised; and I have performed it in many such cases to the manifest advantage of the patient.

# CHAPTER L.

## DISEASES OF THE SPINE.

### SPINA BIFIDA.

It occasionally happens that, from congenital malformation and arrest of development, the spinous processes of some of the vertebræ are deficient, and their laminæ either absent or separated; in consequence of which the meninges of the spinal cord are unprotected, and project through the aperture in the bones, giving rise to a tumour at the part where the arrest of development in the osseous structures occurs.

Characters.—The tumour is usually oval, its long axis corresponding with that of the spine. It generally varies in size, from that of a walnut to an orange; but occasionally it attains an immense bulk, equal to that of a child's head. In some cases the tumour is lobulated, having an imperfect septum stretching across it; in other instances, two or more of these tumours have been met with in the spine. The skin covering it is usually of its normal colour; but when the tumour is of considerable size, it may be thin and have a bluish or congested appearance, and present a certain degree of transparency. In these circumstances, ulceration from distension and thinning of the skin may eventually take place. On examining the tumour, which is hard, though elastic when the child is held upright, it will be found that it becomes soft when the child is laid horizontally. It sometimes becomes tense during expiration, and softer during inspiration. In some cases fluctuation is perceptible, and by pressure the bulk may be lessened.

Spina bifida may be met with in any part of the vertebral column; it is, however, almost invariably found in the lumbar region, the cases in which it appears higher up being of rare occurrence; instances of the kind are, however, mentioned by Cruveilhier. When it occurs higher up, in the cervical or upper dorsal region, it has been found that the spinal cord and nerves are usually adherent to the walls of the tumour; in the lumbar region this is not the case.

The tumour is distended by the cerebro-spinal fluid, which is characterised by its clear limpid appearance, by its low specific gravity (1003 to 1006 being the average), and by its containing merely a trace of albumen, a considerable quantity of chloride of sodium, and a trace of sugar.

Prognosis.—The prognosis of spina bifida will depend upon the size of the tumour, on the condition of the skin covering it, and on its situation. If it be of small size, with healthy integumental investment, and without a tendency to increase, the patient may live to an adult age, provided care be taken to protect the tumour. If of large size, it is generally fatal, the child usually dying at an early age of convulsions. In other instances the tumour increases in size, the skin covering it becomes thin and red, ulcerates, and gives way, and death results from spinal meningitis. Upon the whole, it may be stated as a general rule, that spina bifida is more dangerous the higher it is placed on the spine.

**Treatment.**—In the treatment of spina bifida, the line of practice must be determined by the size of the tumour and by the condition of the skin covering it.

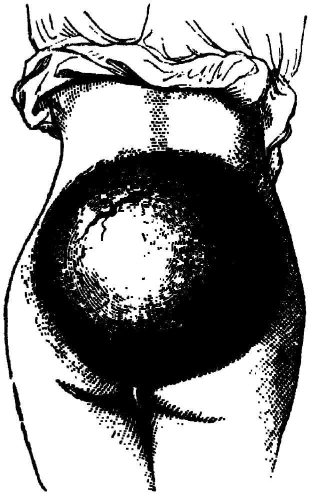


Fig. 472.—Large Spina Bifida, cured by tapping and pressure.

When the tumour is very large, and the skin covering it has become reddened, showing a tendency to give way, tapping and compression combined offer the only chance of safety. The case from which the accompanying drawing is taken was cured in this way. It was that of a young girl. At birth the tumour protruding through the spina bifida was small, but it gradually increased in size, until at the age of thirteen it had attained the following dimensions:—Circumference at base 25 inches; length over greatest convexity 19 inches; breadth 14½ inches. The tumour occupied the lumbo-sacral region, and stretched over both gluteal regions. It was tense and translucent; the skin reddened, very thin, and becoming darkly congested at the more prominent part, evidently in imminent danger of bursting. Health excellent; development good. I tapped the tumour and drew off 101 ounces of cerebro-spinal fluid. When emptied, an aperture 1½ inch long and three-quarters of an inch broad, could be felt at the lower lumbar and upper sacral regions to the left of the mesial line. The parts were well padded with cotton wool and supported by an elastic bandage. No ill effects followed the tapping. This was repeated nine times in eighteen weeks, 985 ounces in all of clear cerebro-spinal fluid being drawn off; the largest tapping amounted to 120 ounces; the smallest to 93. After each tapping, methodical compression was employed. The ninth tapping was followed by signs of irritation in the lining membrane of the tumour, which became greatly thickened, evidently by plastic deposits. Slight spinal meningitis with a tendency to opisthotonos and convulsive movements came on, but passed off. The sac did not refill; and, the skin covering it being thickened and corrugated, the patient soon completely recovered, and is now—four years after the last operation—strong, healthy, and active. Cabral of Lisbon operated successfully by tapping and pressure in a case of spina bifida on a child a month old.

In cases in which the child is otherwise healthy and strong, the tumour small, with sound skin covering it, and in which little pain or inconvenience arises from pressure on it, means may be adopted for relieving or possibly even curing the deformity.

In these circumstances, bearing in mind that the disease is not necessarily fatal, we shall probably best consult the welfare of the child by abstaining from all operative interference, and merely protecting the tumour with a piece of leather or a layer of cotton-wool. If it be thought desirable to attempt a cure, the simplest mode is to employ pressure on the tumour, by means of a compress and bandage; or, what is better, an air-pad, similar to those used for umbilical hernia, and kept in place by an India-rubber band. In addition to pressure exercised in this way, the recommendation of Sir A. Cooper may be followed, and the tumour punctured from time to time with a small trochar; care being taken, however, to prevent the ulceration of the punctures, by covering them with collodion. In this way, by the combination of puncture and compression, cases have been cured. Gradually applied lateral compression has been successful in a few cases. Thus Wilson removed the tumour by the gradual pressure of a clamp applied to its base, and keeping the parts in close apposition by means of this instrument, so as to prevent the entrance of air, and the consequent occurrence of spinal meningitis. In this case the tumour was as large as an orange, and not pedunculated. If it have a narrow base, the prospect of cure by this means will be better. Beynard and Latil applied compression successfully by means of threads passed through quills or small wooden tubes, and gradually tightened. All other plans of treatment, by which the tumour is opened, and the air allowed to enter it, are fraught with danger, and will, I believe, be inevitably followed by the death of the child, from inflammation of the meninges of the cord, and convulsions. In fact, as a general rule, operations for the removal of the tumour are to be condemned. I have never known any but a fatal issue follow its removal by the ligature, scissors, or the knife.

### ANGULAR CURVATURE OF THE SPINE. POTT'S DISEASE.

This disease, which consists, in its full development, of destruction of the bodies of the vertebræ, with disintegration of the intervertebral fibro-cartilage, most commonly occurs in young children, sometimes but a few months old; but it is not unfrequently met with at all ages up to thirty. It is always, I believe, a scrofulous affection, consisting essentially in degeneration of the fibro-cartilages of the spine, or in strumous ostitis; sometimes, but far more rarely, in tubercular infiltration of the bodies of one of the vertebræ, followed, as commonly happens in this condition, by congestion, caries, or necrosis of the osseous tissue that is in contact with, or is the seat of, the deposit.

When we consider the complicated structure, and the variety and extent of the movements of the spinal column, we cannot but be surprised that its organic diseases are so comparatively rare. The quantity of osseous tissue that enters into its formation—a large portion of which is cancellous, and hence peculiarly prone to caries—whether simple or tuberculous—would mark it as a part that ought to be peculiarly liable to these pathological changes. The variety and extent of its ligamentous structure, of its fibro-cartilages, the articulations between the individual vertebræ, and between them and the ribs, all give the necessary elements for chronic disease, which might be considered of probably frequent occurrence when we reflect on the extent, variety, and frequency of its movements. But so admirably is the column as a whole designed for its purposes, that it is much less frequently the seat of organic disease than might *à priori* be supposed to be possible.

**Changes in the Spinal Column.**—Angular curvature of the spine, or "Pott's disease," as it is familiarly called, may originate in disease of two different structures of the spinal column; viz., 1, the intervertebral fibro-cartilages; 2, the bodies of the vertebræ. The seat of origin exercises an important influence on the character and progress of the disease. When it commences in the intervertebral fibro-cartilage, it is seldom fatal, the disease consisting in a strumous and inflammatory softening of these structures, going on to their absorption and the consequent falling together and fusion by bony ankylosis of the bodies of the vertebræ. In these cases, abscess seldom or never occurs, and the angular projection is usually limited to three vertebral spines at most.

When the disease occurs in the bones of the spinal column, it primarily originates in and is usually confined throughout to the cancellous structure of the bodies of the vertebræ, leaving the spines, the arches, and the articular processes, unaffected; but in some instances even those structures become implicated. The disease may begin in two distinct ways: 1, by the development of ordinary strumous osteitis: 2, by the deposit of tubercle in the cancellous structure of the bone. The tubercle so deposited excites inflammation, and leads to disintegration of the surrounding osseous structure. The disease, whether simple strumous osteitis or tuberculous caries from its commencement, attacks the bodies of the vertebræ, which are cancellous, in preference to the other parts of these bones which are composed of compact osseous structure. The bodies of the affected vertebræ become thin, eroded, and gradually hollowed out anteriorly. In this way the bodies of from three to six or eight of the vertebræ may be destroyed; the corresponding intervertebral fibro-cartilages,

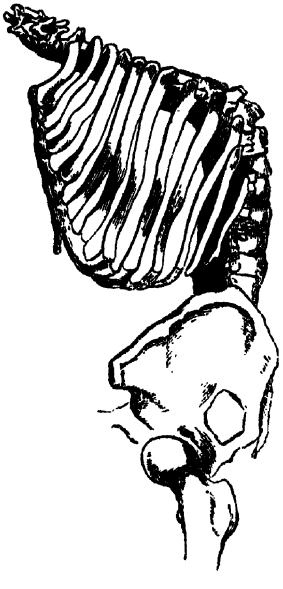


Fig. 473.—Angular Curvature of the Dorsal Spine from Caries and Ankylosis.

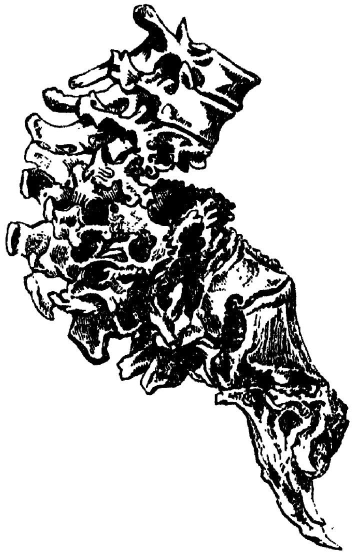


Fig. 474.—Caries of Bodies of Lumbar Vertebræ: no attempt at Ankylosis.

which derive their supply from the contiguous bones, becoming disorganised as these undergo destruction. These changes commonly occur about the middle dorsal vertebræ; if extensive, they may implicate the upper or lower dorsal, or upper lumbar, and give rise to angular projection backwards of the diseased part of the spine, corresponding in extent to the amount of destruction of the vertebræ (Figs. 473 and 474). The mechanism of this excurvation, which is usually the most marked feature in this disease, is easily understood by reference to the pathology of the affection. The bodies (one or more) of the vertebræ, being thinned and weakened, at last give way under the pressure of the weight of the upper part of the body; and, the remains of the disintegrated bodies being fused together, the upper part bends over, and the spines project posteriorly. The degree of bending forwards and of posterior excurvation corresponds to the amount of the destruction of the bodies of the vertebræ. At the same time that the upper part bends forwards, the lower part of the spine rarely maintains the exact position as it did in Fig. 473. In the great majority of cases there is a compensating incurvation just below the excurvated vertebræ. In this way the upper part of the body is carried erect.

The size of the angle of excurvation varies according to the number of the absorbed vertebral bodies and the extent of their disintegration. When one only is diseased it is acute; when several, more obtuse or open. When one vertebra only or chiefly is diseased, three spinous processes will project to form the angle, that of the diseased vertebra being the apex. If two or three be diseased, five spinous processes usually enter into the formation of the angle of excurvation, and then the whole of this portion of the column will be displaced backwards, giving a thickened and broadened base to the excurvation in the lateral direction. It is seldom that the spinal cord becomes compressed, injured, or diseased during the progress of this disease. In some cases, however, more especially in adults, and in those cases in which the posterior excurvation is slight, the spine maintaining its erect position, spinal meningitis may be developed. This is owing to the spinal canal being opened in consequence of the salutary and conservative process of angular ankylosis not having been sufficiently developed. Short of this, a certain amount of paraplegia may be produced from partial compression of the cord. Effusion into the sheath of the cord then takes place, and, the cord itself becoming softened opposite the seat of curvature, paraplegia will be occasioned.

In some cases the bodies of the vertebræ, instead of being carious, are simply eroded, or scooped out, leaving a hard, dry, and somewhat rough osseous surface, which has evidently been the seat of chronic osteitis. These cases are quite incurable; no process of repair taking place.

Symptoms.—Angular curvature, or Pott's disease of the spine, commonly begins, especially in children, in a very insidious manner. It usually occurs in strumous children, and is generally referred to a fall or blow on the back. The first symptom that most often attracts attention is the child's attitude, which is altered and very characteristic. The body is held stiffly straight and upright; it is neither bent nor turned to one side when the child moves, but the spine is moved as a whole and in a rigidly fixed manner. The shoulders are raised, the chin is thrown up, and the toes are slightly turned in. The child walks with great caution, and very stiffly.

One of the earliest symptoms complained of is often an ill-defined superficial pain, extending round the trunk, more severe, perhaps, on one side than on the other, and occasionally referred to the stomach. After a time the child becomes unable to stand upright, has a tendency to lean the body forwards, or to support it by resting the hands on the knees, or by seizing hold of anything that will serve as a temporary support. It will also be found that the patient experiences great difficulty in raising himself without assistance from the horizontal into the sitting position, or in turning himself sideways in bed without the use of his arms. On examination, one or two of the spines about the middle of the back will be found to be a little more prominent than the rest; and, on pressing or tapping upon them, pain will be complained of. The child usually becomes stunted in its growth; and, if the disease be not arrested by proper treatment, the patient continues more or less hump- or round-backed for life. In other cases the disease will run on to the formation of abscess, as will immediately be described, strumous manifestations occurring elsewhere, and death eventually resulting.

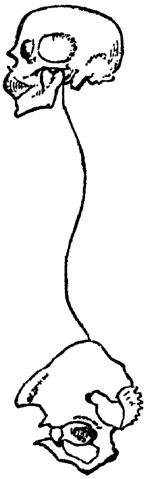


Fig. 475.—Natural Curve of Spine.

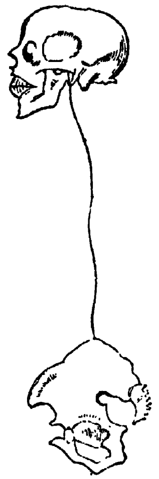


Fig. 476.—First early Change of Curve in Angular Curvature.

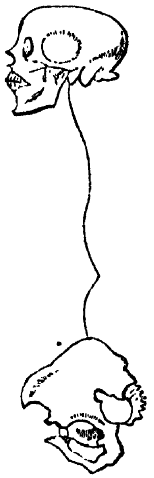


Fig. 477.—Change of Curve of Spine in Advanced Stage of Angular Curvature.

In *adults*, the danger and the symptoms will vary greatly according to the seat of the affection. It is most dangerous, and rapidly fatal, when the cervical vertebræ are implicated; for, as the bodies of these are shallow, caries readily penetrates to the spinal canal, and the cord or its membranes may thus be irritated. When the dorsal or lumbar vertebræ become diseased, the affection is not so immediately serious to the life, as it may be to the figure of the patient. In adults it often commences with flying obscure pain in the loins or back, apparently of a rheumatic character, shooting round the body or down the thighs. On examining the spine, which feels weak to the patient, and which, as in the child, is incapable of supporting him or of enabling him to raise or turn himself without assistance, tenderness on pressure or on tapping will be experienced at one point, and he will wince when a sponge wrung out of hot water is applied to this part; although there may be no appearance of excurvation, yet the skin covering it is hyperæsthetic. In these cases of caries *without angular curvature,* it will be found that the spine has lost its natural free mobility and flexibility, moving fixedly, stiffly, and as a whole, when the patient leans forwards or sideways. The patient, when laid flat on his back, cannot raise himself into a sitting position without the aid of his hands or elbows, and he cannot turn sharply and suddenly over upon his face. Occasionally the incipient curvature, when it occurs, assumes more of a lateral than of an angular direction; and in one fatal case I have seen the spine actually bent backwards, so as to be incurvated at the seat of disease. In some rare cases, the true angular excurvation dependent on caries of the bodies of the vertebræ may be associated with the ordinary lateral curve of debility. The lower limbs now become weak, and the patient walks with a peculiar shuffling tottering gait, the legs being outspread, and the feet turned out. The weakness of the limbs is especially marked in going upstairs, and may be tested by directing the patient to stand unsupported on one leg, and raise the other so as to place the foot upon the seat of a chair, which he will probably be unable to do. Not unfrequently there is more or less of a neuralgic affection associated with the muscular weakness—a species of neuralgic motor paralysis which is very characteristic. Sensation is not only perfect, but over-acute in parts, whilst there is an ataxic state of the muscles of the lower extremities which presents a peculiar and characteristic train of nervous phenomena. The deformity of the spine may slowly increase; the patient may become unable to stand; and spasms of the muscles of the lower extremity may come on together with a tendency to relaxation of the sphincter ani, and retention of urine.

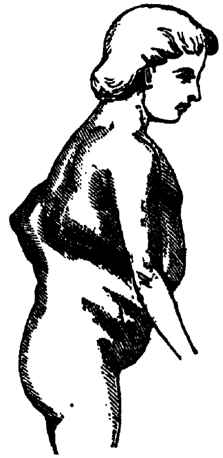


Fig. 478.—Attitude of Child in Angular Curvature in Advanced Stage.

**Abscess** now commonly makes its appearance; and in some cases it occurs before any of the other signs except pain and weakness of the spine, but certainly before any deformity has taken place. When the abscess forms, as Stanley has observed, the pain and irritation of the spinal cord and nerves are usually lessened for a time.

It must not, however, be supposed that abscess necessarily forms in all cases. In children we often meet with great excurvation without any abscess. In adults, however, it is very rare to see angular curvature without suppuration. But the liability to abscess will depend not only on the age of the patient, but on the primary seat of the disease, whether it commence in the intervertebral fibro-cartilages or in the bones of the spine; and, if in the vertebræ, on its origin, whether tuberculous or not. If the disease commence in the intervertebral structures, consolidation of the diseased spine will often take place without the formation of abscess. But when it is situated primarily in the vertebræ, this is much more doubtful; here, however, much will depend on the form of the disease. Simple congestive or inflammatory caries of the spine may take place to a very considerable extent, and yet no suppuration occur; the bodies of the vertebræ undergoing erosion and absorption, and coalescing so as to become fused together in one soft and friable mass of bone, across which bridges of osseous tissue are sometimes thrown out, so as to strengthen the otherwise weakened spine. In these cases, masses of porcellaneous deposit will not unfrequently be found intermixed with and adherent to the carious bone. Indeed, this ankylosis and fusion of the bodies of the diseased vertebræ may be looked upon as the natural mode of cure of angular curvature of the spine; the only way in which it can take place when once the disease has advanced to any considerable extent.

When abscess forms in connection with diseased spine, it is in most cases the result of the continued irritation produced by the tuberculous osteitis; and it may become the most prominent and marked feature of the affection, giving rise almost to a distinct and independent disease. The situation and course of the abscess depend mainly upon the part of the spine affected; thus, for instance, when the cervical vertebræ are diseased, the abscess may come forwards behind the pharynx, and may occasionally extend under the sterno-mastoid muscle to the side of the neck, where it opens; sometimes, though very rarely, it passes into the chest, and in other cases down into the axilla. When the disease is seated in the dorsal vertebræ, it usually passes forwards under the pillars of the diaphragm, down the side of the aorta and the iliac vessels, into the iliac fossa, and then presents through the abdominal wall above Poupart's ligament; sometimes, if the patient be long kept in the recumbent position, the pus sinks into the pelvis, and then passes out through the sacro-sciatic notch, giving rises to a large accumulation in the gluteal region, or it may present by the side of the anus. In other instances, again, the pus passes directly backwards, and large *dorsal* or *lumbar* abscesses are the result. It is remarkable that in these cases of caries of the dorsal vertebræ the pus does not tend to encroach on the chest or the pleural cavity. In other cases, when the lower dorsal or upper lumbar vertebræ are diseased, the pus enters the sheath of the psoas muscle, thus constituting the common affection termed *Psoas Abscess*, and, passing along this, under Poupart's ligament, presents in the thigh; or it may continue its course downwards, burrowing under the muscles of this region, until it reaches the popliteal space, and may even pass from this some distance downwards on to the calf or ankle. I have seen an abscess, which took its origin in disease of the dorsal vertebræ, opened by the side of the tendo Achillis (Fig. 74, Vol. I.). In other cases, again, these abscesses take a different course; and, descending into the subperitoneal areolar tissue of the pelvis, may present by the side of the rectum in the perinæum, or pass out of the sciatic notch, and down by the side of the trochanter. The quantity of pus contained in these collections is sometimes enormous, and abscesses of this description attain a greater magnitude than those of any other part of the body. In some cases the abscess may follow the course of both psoas muscles, and project on each groin at the same time. Their true nature and point of origin may usually be determined by an examination of the spine, and by feeling an impulse on coughing communicated to their extremest points of presentation. Sometimes fragments of the carious or necrosed bone from bodies of the diseased vertebra will be found in the pus—more particularly towards the termination of the case, when recovery by ankylosis is taking place. In the patient from whom Fig. 480 (p. 300) was taken, several fragments of bone thus came away in an abscess that opened in the fore part of the thigh.

DIAGNOSIS.—The diagnosis of caries of the spine is made at the first sight of a patient affected by the disease, when once the angular deformity has taken place. It is, however, difficult before excurvation occurs, being only indicated at this period by the existence of pain in the back, and by some symptoms of spinal irritation. At this stage it may be mistaken for spinal or intercostal *neuralgia*, for *rheumatism*, or for *chronic nephritis*. The persistence, however, of a continuous fixed pain in the back should always lead to a suspicion as to the true nature of the disease, lest the grievous error be committed of treating as mere neuralgia or rheumatism what may turn out to be incurable disease of the spine itself. Here the tenderness on pressure, the increased sensibility to the application of heat will determine the seat of the affection. The pain elicited by rotation or by antero-posterior movement is a very valuable symptom. In most cases pain on bending backwards is most complained of. The patient can stoop forwards, but if bent backwards suffers much. So also pressure on the head or shoulders greatly increases the pain or the part affected. The shape of the back also, as also there is loss of the natural and graceful curves of the spine with a tendency, though it be very slight, to projection of some of the spines, the feeling of weakness in the back, the difficulty in rising from a sitting or horizontal position, in turning, or in standing on one leg unaided, the loss of the natural flexibility of the spine, and especially the occurrence of these symptoms in early childhood or youth, at a period when the other diseases rarely occur, and are still less rarely persistent, would lead one to suspect the true nature of the affection.

The diagnosis between *abscesses* localised in the situations mentioned and those arising from diseased spine, is not always easy ; as purulent collections of various kinds may form in the different planes of areolar tissue in the neighbourhood of the vertebral column, without any disease existing in it. Thus, a large psoas abscess descending in the sheath of the muscle and presenting under Poupart's ligament, may occur from some disease or irritation of the areolar or fascial structures without any disease of the vertebræ themselves. In these cases of simple abscess, the diagnosis from psoas abscess dependent upon vertebral disease is usually easy, as there will be an absence of all excurvation of the spine or even of tenderness along it. As psoas abscess dependent upon vertebral caries almost invariably presents in the groin, and a large abscess in the groin may arise from various other conditions, independently of such vertebral disease, the Surgeon must attend carefully to the diagnosis of these various conditions. *Abscess in the groin* may arise from the following causes :—1, from large lymphatic collections in the subcutaneous or intermuscular planes of areolar tissue ; 2, from disease of the areolar tissue around the kidneys ; 3, from pericæcal abscess (on the right side only) ; 4, from iliac abscess, whether forming merely in the iliac fascia, or dependent on disease of the pelvic bones ; 5, from hip-joint disease, the abscess being pelvic ; 6, from large buboes or glandular abscesses ; 7, from an empyema perforating the pleura and finding its way down behind the diaphragm ; and 8, from serous or hydatid cysts. These various collections may, however, with a little caution be readily distinguished from the ordinary form of spinal abscess that descends along the psoas muscle.

In the first place, in all these cases there is an absence of that dorsal pain and tenderness, with more or less excurvation, which, though not invariably present, is commonly met with in psoas abscess. Then, again, if the collection be *perinephritic*, there will have been previous, or there are co-existing symptoms of renal disease. If it occur in the *areolar tissue around the cæcum*, the pus will be peculiarly offensive, will present itself in a less distinct manner, and will probably be associated with symptoms of intestinal irritation. I have seen the pus in a pericæcal abscess pass under Poupart's ligament, and present as a large sloughy abscess at the upper and outer part of the thigh. In those rare cases in which an *empyema* has found its way between the layers of the abdominal muscles, and presented in the groin, the stethoscopic signs will point out the nature of the affection. In *abscess connected with disease of the hip-joint*, there will be special evidences of the source of the pus. The only real difficulty consists in diagnosing large psoas abscess presenting in the thigh or in other parts of the lower extremity, and dependent on disease of the vertebral column, from *iliac abscess* taking its origin in the loose areolar tissue of the iliac fossa, whether it be connected or not with disease of the corresponding bone; and in these cases the difficulty is often not a little increased in consequence of the iliac abscess finding its way into the sheath of the psoas muscle.

In iliac abscess, the disease usually commences at or after the middle period of life, always in adults; and, as Stanley has observed, usually presents itself externally immediately above Poupart's ligament, being conducted forwards to this situation by the iliac fascia. Psoas abscess, on the contrary, most commonly occurs in the earlier periods of life; and extends down into the thigh along the course of the psoas muscle, so that it always presents below Poupart's ligament. It is also commonly associated with some indication of irritation of the muscle in the sheath of which it is situated; thus, there is an inability to stand upright, to extend the leg, and pain is complained of in walking. Psoas abscess also, in many cases, occurs suddenly, the patient finding, on washing himself in the morning, that he has a large soft tumour in the upper part of the groin; whereas iliac abscess comes on more gradually, and presents in a more diffused and less circumscribed manner.

Iliac and psoas abscesses also require to be diagnosed from certain forms of *aneurism of the abdominal aorta* or *iliac arteries;* which, having become diffused by the rupture of their sac, have formed large non-pulsating extravasations in the sheath of the psoas in the iliac fossa. In such cases the previous history, the absence of distinct fluctuation, and possibly stethoscopic examination, together with the sudden appearance of the tumour, will throw light on the true nature of the case.

In other cases, again, when the abscess, after deeply burrowing, has perforated the fascia lata, its feel closely resembles that of certain *fatty tumours.* Here the possibility of diminishing the size of the swelling on pressure, and impulse on coughing, enable the Surgeon to effect the diagnosis.

From *femoral hernia* the soft and fluctuating character of the swelling, its gradual return when pressure is taken off, its situation external to or below the femoral vessels, and all absence of gurgling, constitute the chief distinguishing characters.

*Large serous collections* and *hydatid tumours* are occasionally met with in the iliac fosia and groin, presenting in their progress, their size, and their fluctuation, all the characters of chronic abscess; from which, however, the character of the fluid let out on puncturing them will immediately distinguish them.

Prognosis.—The prognosis is necessarily unfavourable. It has two aspects: 1, As to the persistence of Deformity; 2, As to the Life of the patient.

1. **Deformity.**—So far as the deformity from angular curvature of the spine is concerned, it may be pronounced to be incurable. The diseased spine is soldered and held together by the fusion of the softened and disintegrated intervertebral structures and vertebral bodies; and any attempt at straightening or at unfolding this excurvation would be attended by the greatest risk, from danger of exciting irritation of the spinal meninges, or opening the spinal canal. When excurvation has taken place, there has been loss of substance; and this cannot be repaired. Hence the spine must remain shortened in front and bent out posteriorly.

2. **Life.**—So far as life is concerned, the prognosis will mainly depend on several conditions. The first is the extent of the caries: if several vertebræ be affected, so that the curve is very long, the disease is necessarily highly dangerous from the extent of osseous structure implicated. It was long ago remarked by Boyer, that the most fatal cases were generally those in which the spine preserved its straight position; whereas, when it was much curved, death seldom resulted. The truth of this remark I have had frequent occasion to verify; and the circumstance would appear to be owing to the fact that, when the spine continues straight at the same time that the bodies of the vertebræ are tuberculous and carious, ankylosis cannot occur, so that the spinal canal is open and the cord irritated; whereas, when they have fallen together and very considerable gibbosity has resulted, ankylosis more readily takes place, and thus an imperfect cure is effected. The size of the abscesses, and the amount of discharge from them, must also necessarily seriously influence the result. If they be very large, and continuously discharging, hectic and consequent death will probably supervene.

Treatment.—In infants, the utmost that can be done is to direct that they be laid prone upon a pillow or small couch constructed for the purpose; that the general health be improved by tonics suited to their age: that they have the advantage of country or sea air; and that some counter-irritant, as the tincture of iodine, be applied by the side of the spine. In children that are somewhat older, and in adults, great advantage may be derived by strictly forbidding them to walk, stand, or sit erect; confining them rigidly to the prone couch, and adopting a general plan of tonic treatment. In fact, the principles of treatment are extremely simple: the improvement of the general health by good diet, tonics, and sea-air, in order to remove the strumous condition with which this disease is always associated. With regard to the value of active pyogenic counter-irritation, by means of issues or the actual cautery, much discrepancy of opinion exists. I cannot but think that these means are employed far too indiscriminately, and often in cases in which more harm than good results from their use. The rule for their employment appears to me to be this—that in the earliest stages of caries of the spine, and *before* the formation of abscess, they are of considerable service, possibly in arresting the progress of the disease in the osseous structures, and certainly in relieving pain and removing irritation of the cord and spinal nerves; but that, after abscess has formed, and is presenting either in the lower iliac fossa or in the thigh, they are not only useless in arresting mischief or inducing repair, but injurious by weakening, and being a source of additional irritation to, the patient. Rest in the horizontal position is the most important element in the treatment; if the patient be allowed to stand upright or to sit, the weight of the head and shoulders will tend to curve forward the weakened spine, and by their pressure increase the already existing irritation in it. The horizontal position relieves the diseased parts of this additional source of distress. In these cases the prone position is preferable to the supine, and the patient, if old enough, should always be laid upon a properly constructed prone couch. The prone position is certainly the best; for not only is the projecting angle formed by the excurvated spine not injuriously compressed, as it would be in the supine or lateral position, but the patient is more comfortable; and it is far easier to make the necessary application in the way of issues and moxæ than could otherwise be done. At the same time, the back not being the lowest part of the body, there is a less tendency to congestion of the spinal veins, and to consequent increase of the inflammatory softening of the bones. When the disease has in this way been arrested, for which many months—at least twelve or eighteen—will be required, the patient may be allowed to get up and move about, by wearing proper apparatus so as to support the trunk. This may be constructed on the plan shown in the accompanying figure (Fig. 479). It combines three principles in its action—1, a broad pelvic band, making a firm basis of support round the lower part of the trunk; 2, lateral upright stems, terminating in crutches, by which the weight of the head and shoulders is taken off the diseased spine, and transmitted directly to the pelvic base; and 3, a posterior plate, which by means of a rachet can be brought to bear directly upon the excurvated part of the spine, and support, and in some degree rectify, the position of this. Taylor's support (Fig. 480) is also an apparatus of great utility, more especially in the advanced stages of angular curvature of the spine, where ankylosis has taken place between the diseased vertebræ. It has a tendency, in consequence of the upright iron dorsal rods being jointed backwards, to uplift the head and shoulders, and thus often improves considerably the attitude of the patient. But this very advantage in the later stages becomes a source of inconvenience if not of positive danger in the earlier periods of the disease, as it tends to separate the vertebræ in process of consolidation. It is of considerable im-

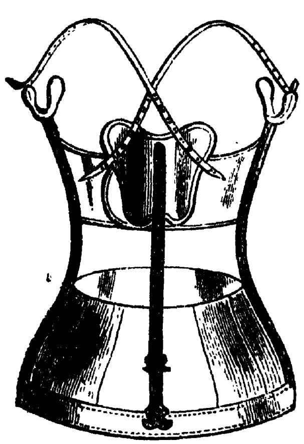


Fig. 479.—Apparatus for Supporting the Trunk in Vertebral Caries.

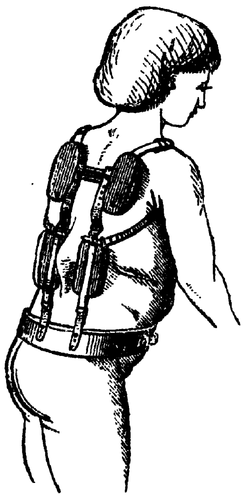


Fig. 480.—Taylor's Spinal Support.

portance that the patient should not be allowed to get or sit up without proper support too soon before the consolidation of the diseased vertebræ has taken place, otherwise he will to a certainty suffer a speedy relapse, and excurvation will greatly increase.

When abscess has formed, the Surgeon should be in no hurry to open it; but, in accordance with the principles laid down when treating of this affection, he should delay doing so, lest injurious fatal constitutional irritation be set up. When it becomes necessary, from the approach of the matter to the surface, to give exit to it, this should be done by aspiration or valvular incision, closed, as soon as the pus has been discharged, by means of hare-lip pins, or in the way described on p. 152, Vol. I., or by the "antiseptic method" (p. 154, Vol. I.).

The hectic or constitutional irritation that supervenes about this period, must of course be treated on general principles.

### DISEASE OF THE CERVICAL SPINE.

We have hitherto considered caries as affecting the dorsal and lumbar spine. But the same disease may be developed, though much less frequently, in the cervical region. The reason of its greater rarity here arises, I believe, from the comparative absence of cancellous structure in the cervical vertebræ, and hence the less tendency to strumous or tuberculous osteitis, the disease probably commencing rather in the ligamentous than in the osseous structures.

The signs are the usual ones of pain, rigidity, swelling, diffused and ill-defined. But there is in the cervical region no tendency to angular incurvations. This is owing to the shallowness of the bodies of the vertebræ not admitting that coalescence after their destruction, which is characteristic of the same disease in the dorsal and lumbo-dorsal regions. But the patient is unable to support or to turn his head; he holds it in his hands when in the upright position, and rotates the whole body when he attempts to look round. There will be pain on any attempt at movement, whether rotatory or antero-posterior, and on pressure on the vertex. Although no angular curvation can, for the reason just stated, take place in this region, the spinous processes may become irregular, one or two projecting more than the other.

**Disease of the Atlas and Axis, and between the Atlas and Occiput,** constitutes one of the most serious forms of vertebral caries. In these cases there are pain and swelling, with great difficulty or absolute inability in moving the head; after a time induration of the areolar tissue, with swelling and fluctuation behind the pharynx, come on, pushing forwards its posterior wall against the nasal apertures, causing the tongue to be extruded, occasioning much difficulty and distress in breathing, and giving rise to a peculiar nasal tone in the voice. The formation of this retro-pharyngeal abscess in young people should always lead to an examination of the cervical spine. The abscess may point here, or may extend outwardly under the muscles of the neck. Patients affected by this disease truly present a remarkable as well as distressing appearance. The sterno-mastoid muscles are remarkably tense and prominent, and, the neck being perfectly rigid, they are unable to turn the head, but when they want to look round have to twist their whole body; at the same time, the weakness in the neck usually compels them to support the head with both hands, putting one under the chin, the other under the occiput, and so holding it. The disease may suddenly terminate fatally by luxation of the vertebræ forwards, compression of the cord, and sudden asphyxia; or more slowly by hectic and gradual interference with the respiratory functions.

The *Treatment* must be conducted on precisely the same principles as that of angular curvature, by absolute rest, counter-irritation, in the early stage, and tonics. As great and immediate danger may result from the sudden displacement of the vertebræ, and the consequent compression of the cervical cord, the head usually requires to be steadied by proper apparatus calculated to support it and limit its movements, such as is represented in Fig. 254, vol. I., and the patient should be confined to the recumbent position.

The **paraplegia** that accompanies severe forms of encurvature of the spine will vary in degree from impairment of motor power in the feet and legs to complete abolition of all sensation and motion in the lower extremities. The feet, legs, and thighs will be utterly insensible to the electric stimulus both as regards muscular irritability and cutaneous sensibility. But however marked the paraplegia, recovery need not be despaired of, provided the sphincters be not affected. I have seen cases of paraplegia from spinal caries, in which the electric sensibility and irritability were completely destroyed, and had been so for a year or two, recover both as to sensation and motion as the activity of the spinal mischief subsided under the influence of rest and appropriate treatment.

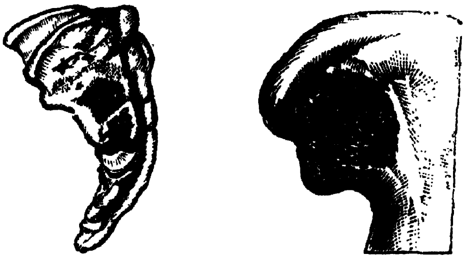
# CHAPTER LI.

## DISEASE OF THE SACRO-ILIAC JOINT.

**Disease of the Sacro-Iliac Articulation** is a rare affection. With but few exceptions, systematic writers on Surgery are altogether silent upon this subject. Boyer and Chelius mention the disease; but it is only by Nélaton that any detailed description of it has been given. This may be partly accounted for by its rarity, and partly, perhaps, by its having not unfrequently been confounded with some of the varieties of coxalgia or of spinal disease.

The sacro-iliac disease is essentially a very chronic affection, lasting for months or years. It appears to be strumous in its origin, partaking of the nature and ordinary character of "white swellings." I have never seen it in young children, and in all the cases which form the basis of these observations it has occurred in young adults from 14 to 30 years old. The exciting causes of the disease are obscure: I have not been able to trace it to blow or injury in any of the cases that have been under my care, although there can be very little doubt that such causes might excite it.

PATHOLOGY.—The disease may commence primarily either in the pelvic bones, or in the articular structures of the sacro-iliac junction. The annexed drawings (Figs. 481, 482), taken from a boy who died of tetanus from the irritation of an issue, six weeks after the commencement of disease in the sacro-iliac articulation, show erosion of the cartilages in patches, and clearly illustrate the existence of primary disease in those structures. The next drawing (Fig. 483), taken from a man about 30 years of age, who died of this affection after nearly two years of suffering, shows the disease in its most advanced stage. The bones, though bare and rough, are neither carious nor necrosed; they appear simply to be deprived of their incrusting cartilage. There is no deep erosion of them, no cavity, no sign of tuberculous infiltration; no evidence, in fact, of primary osseous disease. The ligamentous structures also of the articulations are only partially destroyed. The interosseous ligament was especially in a sound state; it had preserved to a great extent its firmness, and required to be divided with the scalpel in order to expose the interior of the joint and the opposed osseous surfaces. The structures that appear chiefly to have suffered are the synovial and cartilaginous



Sacro-iliac Disease in its early stage.
Fig. 481.—Sacrum. Fig. 482.—Ilium.

elements of the joint. These are normally but imperfectly developed in the sacro-iliac articulation, and may, probably enough, readily undergo disorganising changes somewhat analogous to those which take place in the so-called "pulpy degeneration of the synovial membrane" in strumous joints.

SYMPTOMS.—The symptoms characteristic of this affection arrange themselves in five distinct groups—viz., Pain, Swelling, Lameness, Alteration in the Shape of the Limb, and Abscess. These we must study separately.

1. **Pain.**—One of the earliest symptoms is a sensation of painful weakness at the lower part of the back and sacrum, increased by movements of the body in walking, stooping, or even in standing, giving the sensation as if the body were falling asunder. The pain is increased by any effort that calls the respiratory muscles into action, such as coughing, sneezing, or laughing, and is greatly aggravated by straining at stool. As the disease advances, the pain becomes more continuous, and of a gnawing or rheumatic character. Its intensity varies greatly; in some instances it is throughout slight, except on movement, in others it is most intensely agonising, the patient shrieking with agony, and unable to obtain rest in any position. It is accompanied by a peculiar feeling of weakness, of falling asunder, or of want of support in the lower parts of the body. This pain is confined to the gluteal region and groin, and does not extend far down the limb. When the patient is lying on his back or side, the limb on the affected side may be ab- or adducted, or the head of the thigh-bone may be pressed up against the acetabulum, without any increase of pain, provided the pelvis be fixed by the pressure of the hands. If this be not done, considerable, even intolerable pain will be experienced on moving the limb. So, also, if the Surgeon seize the sides of the pelvis in his hands, and move them to and fro, or press them together transversely, or separate them by pressing the anterior superior spines asunder, pain will be elicited, the affected joint being then influenced by the movement communicated to it. There is often general and diffused tenderness on pressure over the gluteal region; but this is less about the hip-joint than in coxalgia, and gradually increases as the finger is pressed backwards upon the sacro-iliac articulation, so that it may at last be localised in a small spot.

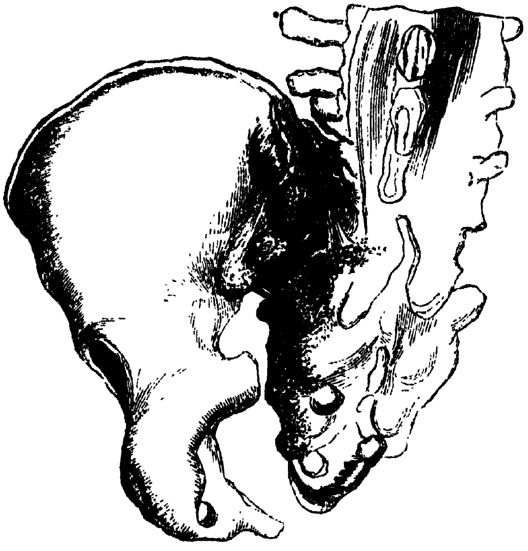


Fig. 483.—Sacro-iliac Disease, more advanced.

2. **Swelling.**—A puffy intumescence is perceptible early in the disease, along the line of the affected articulation. It assumes a somewhat elongated appearance from above downwards, and does not extend to any distance

outwards under the gluteal muscles, nor does it invade the natural hollow behind the trochanter. As the disease advances, and suppuration takes place, the swelling increases materially, and assumes different and peculiar characters, owing to the formation and diffusion of abscess.

3. **Lameness** is an early symptom. The patient walks insecurely; has a feeling of want of proper support to the body; leans forward, and uses a stick. He puts the foot on the affected side to the ground, but does not tread upon it so firmly as upon the other. He cannot stand on the foot of the affected side, or twist himself suddenly round. As the disease advances, the powers of support and progression diminish, and at last the patient becomes unable to assume the erect position, lying in bed usually on the sound side.

4. **Alteration in the Shape of the Hip and Length of the Limb** is an early and marked symptom. From the very commencement of the disease, the limb on the affected side will seem to be longer than the sound one; the tip of the inner malleolus being usually, as the patient lies on his back, half an inch below the level of the same point of bone on the opposite side. But on close examination, it will be found that the measurement from the anterior superior spine to the inner malleolus gives the same result on both sides; hence the elongation cannot be owing to any change that has taken place in the bones or in the three large joints of the lower extremity, but must be dependent on some disturbing cause situated beyond the anterior superior spine of the ilium. On more close investigation, this point of bone is found to be at a lower level, and at the same time more prominent, than its fellow on the opposite side: the displacement is thus produced, not by any obliquity of the pelvis consequent on a twist on the lumbar spine, as in hip-joint disease, but by the tilting forwards and rotation downwards of the whole side of the pelvis; for the displacement which takes place is a double one. The swelling of the affected articulation not only pushes forwards, but rotates downwards, the anterior and superior portion of the ilium; and hence the anterior superior spine is not only at a lower level, but is also more prominent on the diseased than on the sound side. The limb itself usually lies straight, and is wasted and enfeebled.

5. **Abscess** occurs only at a late period of the disease. Many months, a year or more, may elapse before suppuration is fairly established, or, at all events, before the formation of pus is so abundant and so circumscribed that it can be recognised as an abscess. I have observed abscess in connection with this disease in five situations—viz., over the articulation, in the gluteal and in the lumbar regions, within the pelvis, and in connection with the rectum.

The first indication of abscess is met with over the diseased articulation. The puffy swelling which is there perceptible in the earlier stages of the affection, gradually softens, until at last fluctuation is established in it. From this point it may spread outwards into the gluteal region, nearly as far as, but not enveloping, the trochanter; or it may take another course and stretch upwards, forming a considerable accumulation in the loin, upon and just above the crest of the ilium. These forms of sacro-iliac abscess are *extra-pelvic;* the other varieties are *intrapelvic.* These latter are of three kinds. In one form the pus passes out of the sciatic notch, and under the gluteal muscles; in the other varieties it gravitates downwards into the ischio-rectal fossa, and presents by the side of the rectum; and in the third variety which I have observed, the abscess opens into this gut, abundant puriform discharge takes place *per anum*, and, flatus from the bowel passing into the suppurating cavity, a tympanitic abscess results.

PROGNOSIS.—The prognosis of this disease is always most unfavourable. I am not prepared to say that it is of necessity fatal, but I have never seen a patient recover after the full development of the disease, and after suppuration had set in. I have, however, seen a case cured, in which, from the history of the symptoms, the thickening over the sacro-iliac articulations, and the permanent displacement of the side of the pelvis, there was every reason to believe that this disease had existed. But in this instance no abscess had formed.

DIAGNOSIS.—The diagnosis of sacro-iliac disease is important, and not always easy. There are five distinct affections with which it may be confounded—viz., neuralgia of the hip, sciatica, spinal disease, coxalgia, and disease of the pelvic bones.

1. *Neuralgia of the hip* in young females may readily enough be confounded with the earlier stages of sacro-iliac disease. But the widely spread and superficial nature of the pain in the neuralgic affection, the co-existence of the hysterical temperament, the sex of the patient, and the absence of all limitation of morbid action to the neighbourhood of the diseased articulation, render the true nature of the affection sufficiently clear. The obliquity of the pelvis which occasionally occurs in neuralgia of the hip, and causes apparent elongation of the limb, is readily removed when the patient lies on the back; whereas, in sacro-iliac disease, position does not affect the displacement of the limb on the affected side.

2. *Sciatica.*—In this affection, the age of the patient, usually more advanced than that of the subjects of sacro-iliac disease; the seat of the pain, below the articulation, and its extent down the back of the limb; with the absence of elongation, will enable the Surgeon to effect the diagnosis.

3. From *spinal disease*, the diagnosis is usually sufficiently easy; for, although the situation of abscess resulting from caries of the vertebræ may in many cases be the same as that which is occupied by the collections of pus resulting from sacro-iliac disease, yet in caries of the spine, in the vast majority of instances, excurvation of the vertebræ has become prominently marked by the time that the abscess has assumed so great a magnitude as to occupy the inferior lumbar or gluteal regions. In those rare cases in which, as in an instance that was some time ago under my care, caries of the vertebræ, with consecutive abscess, takes place without any angular curvature, it will be found that the patient complains of tenderness on the Surgeon percussing the spine opposite the seat of disease; that the spinal column has lost its flexibility, moving stiffly and as a whole; that there is an absence of that elongation of the limb on the affected side, dependent on displacement of the wing of the pelvis, which is so early observable in sacro-iliac disease; and lastly, that examination of the sacro-iliac synchondrosis neither elicits pain nor reveals swelling or any of the other signs of disorganisation of that articulation.

4. *Coxalgia* is the affection that is most easily confounded with sacro-iliac

disease, and that from which it is of most importance to make the diagnosis. It is especially from that variety of hip-disease which commences in the acetabulum, primarily involves the pelvic bones, and only secondarily implicates the joint, that it is difficult to distinguish sacro-iliac disease; and the importance of effecting this diagnosis is great when we reflect that these cases of hip-disease may now successfully be subjected to operative interference, whilst sacro-iliac disease does not admit of relief or removal by these means. The diagnosis between coxalgia in all its forms and the disease we are at present considering may be effected by attention to the following circumstances.

*a.* The seat of pain on pressure varies. In hip-disease the patient suffers most severely when pressure is exercised deeply behind and above the trochanter, in the hollow behind that osseous prominence, or when the compression is exercised against the anterior part of the hip-joint through the pectineus muscle. In sacro-iliac disease, little or no pain on pressure is experienced in these situations; but tenderness is elicited by pressure upon the sacrum and along the line of junction between the sacrum and ilium, behind and altogether away from the hip.

*b.* The movements that occasion pain are different in the two diseases. In hip-disease, abduction and rotation outwards, or pressure of the head of the thigh-bone into the acetabulum, aggravate, to a greater or less degree, often to an unbearable extent, the sufferings of the patient. In sacro-iliac disease the thigh may be moved in all directions, ab- or adducted, rotated, flexed, or extended, whilst the patient is lying on the back, without any increase of suffering, provided the side of the pelvis be fixed by the Surgeon. Should this precaution not be taken, the movement impressed on the thigh will be communicated to the diseased articulation, and will necessarily occasion suffering.

*c.* The signs connected with the alteration in the length of the limb differ in the two diseases. In hip-disease there may be, and usually is in the advanced stages, considerable shortening. This never occurs in sacro-iliac disease. In the earlier stages of coxalgia there may be, as there is throughout in sacro-iliac disease, elongation of the limb. But there is an important point connected with this. The elongation in hip-disease is always appreciable by measuring from the anterior superior spine of the ilium to the inner ankle. In sacro-iliac disease, however, the measurements between these two points on the opposite sides of the body exactly correspond, the seat of the elongation being situated still higher up.

*d.* The alteration of the level and of the prominence of the two anterior superior spines, in sacro-iliac disease, may be confounded with that arising from the obliquity of the pelvis usually occurring in the early stages of coxalgia. But here also the diagnosis may be effected by observing that the displacement of the bone in sacro-iliac disease is permanent, and is not influenced by position. The obliquity of the pelvis in hip-disease, giving rise to apparent elongation of the limb, is dependent on a twist in the lumbar spine, which may be rectified by placing the patient on his back, and using a little manipulation. The alteration in the level of the two ilia, in sacro-iliac disease, is not modified by change of position, or by any movement that may be impressed upon the spine.

5. *Disease of the pelvic bones* may of course occur independently of any affection of the sacro-iliac articulation; and, when so occurring, it always commences at a distance from the joint—the crest of the ilium, the tuberosity of the ischium, or the acetabulum, being the usual seats of the disease. When it occurs in the first of these two situations, the resulting abscess seldom attains a very large size, and is altogether above or below the synchondrosis, the outline of which can be felt clear and unobscured by swelling of any kind. When the abscesses are opened, the sinuses that result will lead directly down to the rough and carious bone, examination of which will leave no doubt as to the nature of the cases. In these cases, also, no change takes place in the length of the limb, or in the position of the side of the ilium.

When the acetabulum is primarily affected, the difficulty of diagnosis may be greater, in consequence of the large size and often intrapelvic nature of the abscesses, and the co-existence of a certain amount of displacement or elongation of the limb. But here the same circumstances that enable the Surgeon to effect a diagnosis in ordinary coxalgia—viz., the pain in movement influencing the hip-joint merely, and the increased length of limb, as determined on measuring from the anterior superior spines—will prevent his falling into error as to the true nature of this disease.

TREATMENT.—With respect to treatment I have but little to say, and that by no means satisfactory. The treatment must be conducted on the same general principles that guide us in the management of cases of carious diseases of the spine. The great object is to prevent the formation of abscess. If the cure be fortunately accomplished, the patient will probably recover with a limb that, though weakened, is but little impaired in utility; for, the sacro-iliac junction being naturally a fixed joint, it matters little if it become ankylosed by disease. Long-continued rest in the prone position; fixing the pelvis, hip-joint, and thigh by means of a large leather cap and splint, which should embrace the whole of the limb from above the crest of the ilium to the sole of the foot; counter-irritation, in the earlier stages, before suppuration has set in (after that has occurred it is worse than useless); the administration of cod-liver oil, iron, and suitable tonics, are the means to be employed. When abscess forms, this must be opened in a suitable and convenient spot, when large and chronic by valvular incision; and keeping up the powers of the patient by ordinary dietetic means and medicinal tonics are the means that must be employed, with the view of procuring ankylosis; but usually, unfortunately, with little advantage beyond the mitigation of suffering and the prolongation of life for a limited time. When once suppuration has set in, our hopes of a cure are materially lessened. I am not prepared to state that the affection is inevitably fatal when it has reached this stage, but certainly in the very great majority of instances it is so; the profuse discharge from the large abscesses connected with it inducing hectic, and exhausting the powers of life. No operative interference is admissible.

# CHAPTER LII.

## DISEASE OF THE HIP-JOINT.

Hip-disease presents so many points of peculiar and serious importance, that it is usually, and not improperly, considered as a distinct affection, apart from other joint-diseases. Like all these it may be acute, subacute, or chronic, most commonly occurring in strumous subjects; indeed, I think its connection with scrofula is generally more distinctly marked than that of most other affections of the joints. It almost invariably occurs before the age of puberty. Out of 48 consecutive cases of this disease, of which I took notes, I find that in 16 only did it take place at or after fifteen years of age, and, of these, in 6 cases only it happened above the age of twenty. The collected statistics of cases appears to give a very similar proportion; thus it may be considered essentially a disease of childhood or early youth. It commonly comes on from very slight causes; being usually attributed to over-exertion in a long walk, a sprain in jumping, a fall, or sitting in the wet.

Forms of the Disease.—All the inflammatory affections attacking the coxo-femoral articulation are usually confounded under the term "Hip-Disease" or "Coxalgia." This is too general an expression; and we shall find included under it several distinct forms of disease that differ from one another in pathology, symptoms, result, and treatment. On looking at the hip-joint in a surgical point of view, we find it to be composed of three distinct parts; viz., the soft structures, the acetabulum, and the head of the thigh-bone. Any one of these may be principally or primarily affected; and we may accordingly divide hip-joint disease into three distinct forms—Arthritic, Acetabular, and Femoral. This division is not purely pathological, but is also practical, especially in its bearing on the question of excision.

General Pathological Conditions.—Before proceeding to describe each separate form of coxalgia in detail, we may consider briefly the six pathological conditions which are more or less common to each variety of the affection—viz., Pain, Attitude, Suppuration, Sinuses, Dislocation, and Ankylosis.

1. **Pain.**—The pain in the hip-joint disease varies greatly according to the form which the affection assumes. In the more chronic forms of the disease it is at first slight, and, perhaps, rather referable to the knee than to the hip; this is particularly the case in the *femoral* variety, and may be explained by the irritation of the articular branch of the obturator nerve. In the *arthritic* form it is always very acute, even intense, seated in the joint itself, and greatly increased by any movement, however slight, of the limb. In the *acetabular* form of the disease the pain is not at first referred to the joint, but rather to

the iliac fossa or side of the pelvis; it afterwards becomes severe, gnawing, and deeply seated in the articulation. However slight the pain may be, it is always greatly increased by moving the limb, by pressing the surfaces of the articulation together, or by abduction. Hence the patient usually keeps the foot raised and merely supported on the point of the toes, the knee and hip being flexed and adducted.

2. The **Attitude** of the limb is peculiar, and varies in different stages of the disease. In the early stage the limb is usually straight, carried slightly forwards, or perhaps somewhat abducted, owing to the irritation and contraction of the capsular muscles on the anterior and outer aspects of the joint. The attitude of the limb is as follows. 1. The patient tilts the pelvis to the opposite side so as to raise the diseased limb off the ground; hence there is apparent shortening, though there may be no difference in the length of the limbs or even actual elongation. The anterior superior spine on the affected side will be found to be higher than that on the opposite one. 2. The limb is slightly abducted; and 3, the patient only puts the toes to the ground, the heel being raised. This is done in order to bring the elasticity of the foot into play and to prevent the pain that would arise from the jar of the limb if the patient trod on the heel. As the disease advances, the limb becomes adducted, so that the knee is carried against the lower part of the sound thigh; it is also flexed and carried forwards in advance of the opposite limb, the action of the external rotators having become interfered with by wasting and agglutination, and the limb coming under the influence of the adductors and flexors. The *length* of the limb varies greatly at different periods. In estimating the length, we must be careful to discriminate between apparent and real changes. In the early stages there is often apparent elongation to a considerable extent, owing to the oblique position in which the pelvis is carried causing the anterior superior spine on the affected side to be an inch or two below the level of that on the healthy side. Often in these cases of apparent elongation there is actual shortening. All this can readily be determined by measurement from the anterior superior spinous process to the inner malleolus of each side. Real elongation is not common, but may occur in consequence of effusion into the joint, and thrusting down of the head, in acute arthritic coxalgia. As the disease advances shortening comes on, from disintegration or dislocation of the head of the bone. The real shortening is often apparently much increased by the oblique tilting of the pelvis upwards on the affected side. The real shortening of the limb is often very easily observable by placing the patient in the sitting posture, with the knees bent at a right angle, when it will be found that the knee on the side affected does not project so far forwards as the one on the healthy side.

3. **Suppuration** is not a necessary consequence of inflammation of the hip-joint, though in strumous subjects it more commonly occurs than not. We often see the *arthritic* variety of the disease run its course without suppuration; but, in the *acetabular* and *femoral*, abscess always forms sooner or later, being the direct consequence of the diseased osseous tissue. In the *acetabular* form, abscess is often one of the earliest signs of serious mischief, preceding the other signs immediately to be mentioned. The abscesses usually form behind the joint, under the gluteal muscles; they may open in this situation or burrow

under the fascia lata, and present on the outer aspect of the thigh below the tensor vaginæ femoris. Sometimes they occur in front of the joint under the pectineus; and in the acetabular form of the disease they are commonly intrapelvic, forming in the iliac fossa, and presenting above or under Poupart's ligament, or passing down by the side of the rectum or through the sciatic notch, and then downwards upon the back of the thigh.

4. **Sinuses.**—An attentive examination of the position and direction of these is of great importance in forming an opinion as to the seat of the osseous disease. There are three situations in which sinuses are met with, which vary according to their point of origin from the abscess, and the position of the diseased bone: hence it is of importance to note their site and direction. 1. When the sinus opens two or three inches below and a little in front of the great trochanter, about the insertion of the tensor vaginæ femoris muscle, the disease is almost invariably *femoral*. 2. When the sinus is in the gluteal region, it may indicate *femoral*, but not unfrequently is dependent on *pelvic* disease; the acetabulum, or a portion of the dorsum ilii, being the part involved. 3. The sinus may open in the pubic region, either above or below Poupart's ligament: in this situation it is almost certainly diagnostic of disease of the *pelvic* bones, especially the pubic aspect of the acetabulum. When it appears *above* the ligament, it probably leads to intrapelvic abscess: on the other hand, when it opens *below* Poupart's ligament, there is generally disease of the rami of the pubes or ischium.

The situation of the sinuses, as well as their direction, will thus be found to be of the greatest value in leading the Surgeon to a more accurate diagnosis of the seat and extent of the osseous disease than he could otherwise form. And, indeed, it is only by attention to these circumstances that he is enabled in many cases to form an approximate opinion on these points; for the diseased bone is often so covered in by healthy osseous structure, as when the inner aspect of the great trochanter is affected, or by plastic matter, that the probe cannot touch it; or the sinus may be so tortuous that a straight probe cannot follow its windings. Sayre's vertebrated probe (Fig. 406) is very useful in these cases.

But there is other important information obtainable from an attentive consideration of the situation of the sinuses. It is with reference to the probable nature of the osseous disease. In *femoral* coxalgia, this is almost invariably caries—sometimes simple, in other cases tuberculous; hence those sinuses that indicate the existence of primary disease of the upper epiphysis of the thigh-bone prove this to be of a carious nature; whilst, on the other hand, sinuses occurring in the pubic region and by Poupart's ligament are almost invariably dependent on the presence of necrosed bone—necrosis being the form of disease that affects the acetabulum and pelvic bones.

5. **Dislocation.**—In the advanced forms of hip-disease, dislocation of the head of the thigh-bone commonly occurs, and may arise from three causes. *a.* The joint may be destroyed; the capsular ligament having given way in consequence of inflammatory softening and ulceration, and the head of the bone being thrown out of the cavity by the action of the surrounding muscles. *b.* Caries and partial absorption of the head of the thigh-bone may have taken place, so that it no longer fills up the cotyloid cavity; and, the ligaments being

at the same time destroyed, it slips out on to the dorsum ilii (Fig. 484). A fungus fibro-plastic mass may sprout up from the bottom of the cavity, and thus tend to push the bone out of it; and, after it has been so extruded, this growth will completely fill the acetabulum.

The occurrence of dislocation is, in the great majority of cases, preceded by the formation of abscess in and around the joint; but in some instances it happens in consequence apparently of the softening of the ligaments, the head of the bone being thrown out of the acetabulum without the supervention of abscess or any sign of suppuration. In these cases a false joint may be formed upon the dorsum ilii, where the bone lodges. When it is lying in a suppurating cavity it will always be found to be in a carious state, and then no attempt, or at most an imperfect one, is made at the construction of an articulation around it.

Dislocation takes place chiefly in the *femoral* variety of the disease, in which the head of the thigh-bone is more or less destroyed, and the acetabulum is filled with fibro-plastic deposit, which is reparative material, developed in those cases in which the lining cartilaginous surface of the joint has been removed, leaving roughened bone, which thus becomes covered. The formation of this material is interesting, as showing the possibility of repair in the acetabulum when it is only secondarily affected. In the *acetabular* form, the position of the head of the bone is more uncertain. In some cases it is dislocated upon the dorsum ilii; in other instances, the head of the bone is not thrown out of the cotyloid cavity; but this, being carious, and becoming at last perforated, may allow the upper end of the thigh-bone to slip into the pelvis.

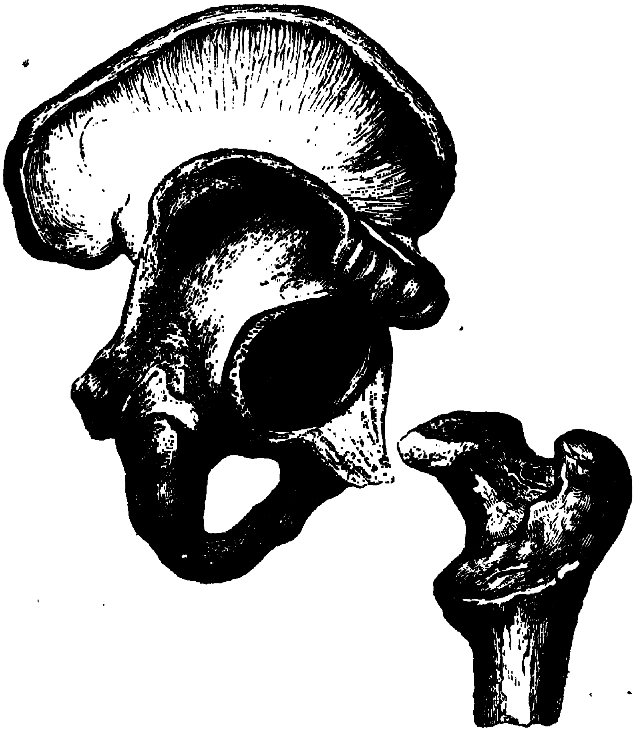


Fig. 484.—Acute Disease of Hip-joint in an Adult. Absorption of Head of Femur. Softening of Ligaments. Dislocation on the Dorsum Ilii.

6. **Ankylosis** may occur either with or without previous suppuration. If the joint have suppurated and the head of the bone be thrown on the dorsum ilii, a false joint may eventually form, or osseous ankylosis in a more or less faulty position take place. If the head of the bone continue in the acetabulum without suppuration, osseous ankylosis may ensue with but little shortening of the limb.

P**ATHOLOGY**.—It is not often that the opportunity presents itself of examining a hip-joint in the earlier stages of coxalgia, before complete disorganization of the joint has taken place. The following were, however, the appearances that were found in a child about eight years of age, who died in the Hospital of pneumonia, and whose body was carefully examined by Wilson Fox. The disease of the hip had only existed about six weeks.

The joint, which, including the acetabulum and capsule, was removed entire, contained a considerable quantity of dirty yellow pus. The ligamentum teres was flattened and covered with spots of yellow lymph: it was much softened, so as to tear with the greatest ease. The synovial membrane was generally greatly thickened, intensely injected, of colour varying from bright red to dull orange, and covered by spots of yellow lymph. The cartilage lining the acetabulum appeared to be healthy, except just around the insertion of the ligamentum teres, where it was softer and more gelatinous-looking than normal for about one to two lines. The cartilage incrusting the head of the femur appeared at first sight to be entirely unaffected.

On making a vertical section through the acetabulum, and the head and neck of the femur, the great trochanter was found almost entirely unossified, with the exception of a point in its centre, and its connection to the bone was weak and easily torn asunder. The epiphysis of the head was completely ossified; the line of junction being still, however, marked by a band of bluish and very hard cartilage, which extended for about three lines on each side across the bone. In the centre of this, extending both into the epiphysis and the diaphysis, was an eburnated portion of bone, yellow, hard, dense, and compact, these peculiarities being most marked in the portion belonging to the diaphysis. In both parts this mass contrasted strongly in colour and in consistence with the reddened cancellous tissue. The incrusting cartilage, though generally appearing healthy externally, could now be seen to be a good deal worm-eaten internally, and indeed, destroyed at one or two points. Where the mass of hard bone came near the surface, the reflexion of the synovial membrane was destroyed. Below this, in the neck and the upper part of the shaft, the cancellous tissue was very lax, the walls being very thin, and the medulla filling them extraordinarily red. The medulla at the commencement of the medullary canal, about one inch and a half below the trochanter, was exceedingly red and vascular. Occupying many spots of the cancellous tissue, and also one or two of the reddened medulla, were many little masses of the size of millet-seeds, looking like transparent cartilage, hard and resisting, yielding no juice, not breaking down at all easily under the finger, torn with difficulty by the needle, and when torn showing great numbers of nuclei and fibres. They pervaded the whole bone, and were also found in the acetabulum, but in smaller numbers. Some of them could easily be enucleated where the medulla was soft, others could only be separated with difficulty from the cancellous bone.

From this account it is easy to perceive that the disease was tuberculous; that it commenced in the osseous structures, chiefly of the femur; and that it secondarily implicated the soft articular structures.

**Arthritic Coxalgia.**—The arthritic form of hip-joint disease may commence in any of the soft structures of the joint; in the capsule, the synovial membrane, the cartilages, or the round ligament. These are alone primarily affected, usually with acute inflammation presenting the characters of arthritis in other joints, and the disease generally continues limited to these structures throughout. Aston Key believed that the round ligament was very frequently the starting-point of inflammation of the hip-joint, and other Surgeons have referred its origin to each of the other structures mentioned. Without denying the possibility of disease sometimes commencing in the ligaments, illustrative of which we have a beautiful model in the Museum of University College, I believe that it more frequently appears first in the cartilage incrusting the head of the thigh-bone; for, though it is extremely difficult to prove this, opportunities of dissecting this form of hip-disease in its early stages being very rare, yet the symptoms that attend it so closely resemble those accompanying the diseases of the articular cartilage in other joints, that it is difficult not to infer that this may be the case in the hip.

*Symptoms.*—In this form of the disease the patient is seized with signs of acute inflammation of the joint, coming on rather rapidly, and with great constitutional disturbance and pyrexia. The pain in the joint in these cases is most excruciating, accompanied by spasms and twitchings of the limb, and marked by nocturnal exacerbations. The suffering is so intense, that the patient cannot bear the slightest movement of the limb; a fit of coughing, the weight of the bed-clothes, or the shaking of the bed by a person leaning against it will give rise to the most intense agony; and in the intervals of his suffering the patient is in constant fear of a return of the pain, to which he looks forward with much anxiety. In these cases the limb is everted, abducted, perfectly helpless, and motionless: the nates will be found flattened, and there is usually some fulness about the anterior part of the joint, under the pectineus muscle, or to its outer side, above the trochanter. There is also sometimes true elongation of it, in consequence of the capsule becoming distended with fluid, and pushing the head of the bone downwards. On measuring the limb, in order to ascertain its true length, it is necessary to examine the two together, and to place the sound in exactly the same position as the diseased one; unless this be done, error will very probably creep in, for, on measuring the lower extremity from the anterior superior iliac spine to the lower border of the patella or the inner ankle, it will be found to be of greater length when adducted or extended than when abducted or bent.

In some cases the distension of the capsule with synovial fluid, as the result of the inflammation in the joint, may be so great as to lead to its rupture, and to the sudden dislocation of the head of the bone on to the dorsum ilii, with great pain and much shortening; this, however, is of very rare occurrence, the dislocation seldom taking place until after abscess has formed within the joint, and the articulation has been thus destroyed.

*Results.*—In this, the arthritic form of hip-disease, various terminations may take place; the result depending greatly upon the constitution of the patient, and on the manner in which the affection is treated. In the most favourable circumstances, as the inflammatory action is subdued, the disease falls into the subacute condition, and recovery gradually but very slowly takes place, with a limb that continues somewhat stiff and partially ankylosed, as well as wasted and somewhat shortened from disuse. Sometimes complete ankylosis occurs without the previous formation of abscess. In the majority of instances, however, abscess forms, and then the patient may either be worn out by the continued irritation of diseased bone, or by the profuseness of the discharge; or, great shortening taking place either by the absorption of the head of the bone, or its dislocation out of the acetabulum, the cavity of the abscess may ultimately contract, the carious portions of bone exfoliate, and the sinuses close after years of suffering. In the most favourable circumstances, when once the joint has been acutely inflamed, a year or two will elapse before the patient can use his limb with any degree of security. The safety of the patient depends in a great measure on preventing the occurrence of suppuration. If the constitution be very strumous, this can rarely be done; but, if it be tolerably healthy, the disease may be prevented from passing on to this stage, and then the patient may recover with an useful though somewhat stiff and crippled limb. If suppuration occur, it is very seldom that an adult patient recovers, hectic and exhaustion speedily carrying him off. The lives of children may, however, be saved even in these circumstances; but they will be left permanently lamed.

**Acetabular Coxalgia.**—In the acetabular form, the disease originates in the pelvic bones, and the articulation and head of the thigh-bone are only secondarily involved. The disease of the pelvic bones has more of the character of necrosis than of caries; but the two morbid conditions are in many cases co-existent, the acetabulum being carious, whilst the rami of the pubes and ischium are necrosed. The soft articular structures speedily become disorganised; the cartilage incrusting the head of the thigh-bone is absorbed; the femoral head itself becomes eroded rather than carious; but the disease does not extend into the neck or trochanters. This form of hip-joint disease is more common in adults than any other variety.

The *Symptoms* are usually obscure in the early stages, but become very unequivocal as the disease advances. There is pain around the hip rather than in the joint itself; this, however, becomes tender on pressure, and the patient cannot bear on the limb, but no alteration takes place in its length, although it becomes greatly wasted. Abscess invariably forms, perhaps at first within the pelvic cavity; but it soon presents externally. Sometimes it passes down by the side of the rectum, or through the sciatic notch to the gluteal region; but generally it points near the pubes, under Poupart's ligament. Hectic comes on; the sufferings are greatly increased; and death from exhaustion speedily ensues in this, which is by far the most fatal form of hip-disease. In cases of this form, dislocation, though it is met with now and then, rarely takes place. Sometimes, however, the destruction of the acetabulum is so extensive that the head of the thigh-bone penetrates it, and passes into the pelvic cavity. Dislocation is most frequent when the disease has destroyed the head of the bone; so that, the head being no longer present, no impediment is offered to the action of the muscles around the joint, and the bone at length slips from its position in the cavity of the acetabulum.

**Femoral Coxalgia.**—In the femoral form of coxalgia, the morbid action commences in the upper epiphysis of the thigh-bone. The progress of this variety of coxalgia is very insidious: its symptoms are by no means prominent; it generally occurs in young children, and is usually, I believe, of tubercular origin. In it the yellow, somewhat soft, friable matter fills up the cancelli of the head and neck of the thigh-bone, resembling, and indeed being identical with, tubercular deposit in other organs. This form of coxalgia is accompanied inevitably by the formation of abscess in the soft parts around the joint, commonly on the outside of the thigh, and in the gluteal region; the articular surfaces are eventually destroyed, and the head of the bone becomes carious and is displaced, leading to shortening and distortion of the limb; the disease very generally terminates in death from exhaustion and hectic.

*Symptoms.*—The disease usually commences very insidiously. It assumes a subacute character, and is chiefly met with in young children. The first symptom that usually attracts attention is, that the child limps and walks in a peculiar shuffling, hopping manner; he does not stand firmly upon both feet, but rests on the toes of the affected limb, the knee of which is bent. The limb will be seen to be everted, somewhat abducted, slightly flexed upon the thigh, with the knee partly bent, and apparently shorter than the other. This shortening, however, is apparent, and not real; for on laying the child on its back, it will be found that the pelvis is placed obliquely; the anterior superior spine on the affected side being raised to a higher level than that on the sound one, and at the same time turned somewhat forwards. Measurement of the limb from this point to the ankle will show that there is no alteration in its length. The obliquity of the pelvis, which is of very early occurrence in diseased hip, is owing to the child lifting the foot off the ground in order to avoid pressure on it in walking or running; and in doing this he is obliged to raise, not only the limb, but the corresponding side of the pelvis. This apparent shortening will commonly give place, after keeping the child in bed for a few days, to a simulated elongation of the limb; the pelvis on the affected side descending below its natural level. At the same time that these symptoms are noticed, the child usually complains of pain in the hip, especially on pressing over the pectineus muscle, or behind the trochanter; this is increased by standing, walking, or any attempt to bear upon the joint; abduction also, and rotation of the limb outwards, are particularly painful, and any concussion of it, as by striking the heel or knee, will greatly increase the suffering. At this stage of the disease, the patient will often refer to the knee rather than the hip as the seat of pain, and a careless Surgeon might be misled and treat the wrong joint; the more so, as there is not unfrequently a good deal of cutaneous sensibility about the inner side of the knee-joint. This pain appears to be seated in the obturator nerve; the articular branch of which, sent to the hip-joint, becoming implicated in the disease, communicates a radiating pain that is felt at the extremity of the long descending branch which is distributed to the knee. On turning the child upon its face it will be observed that the nates are somewhat flattened, the fold being in a great measure obliterated; and, if it be a female, the labium on the affected side will be seen to be placed at a lower level than on the sound one.

As the disease advances, abscesses may form at any part in the vicinity of the joint. They most commonly occur under the glutei muscles; but sometimes at the anterior part, under the pectineus muscle. When in this situation, they occasionally give rise to very severe suffering down the inner side of the thigh by exercising pressure upon the obturator nerve, which may sometimes become tightly stretched over the subjacent cyst of the abscess.

It is about this period that true shortening of the limb takes place, which at the same time becomes abducted and inverted, thus assuming a very different position from that which it presented in the early stage of the disease. The different positions into which the limb falls in the two stages of the complaint are evidently due to alterations in the muscular action brought to bear upon it. In the early stage, the strong external rotators, which are in close relation with the joint, become irritated by the extension of inflammatory action to them, or by the pressure to which they are exposed by the distended capsule ; and hence, these being called into increased action, the limb is everted, at the same time that it is slightly flexed and abducted by the irritation to which the psoas and iliacus are subjected. As the disease advances, these muscles become wasted, undergo fatty degeneration, absorption, or disintegration, by the formation of abscesses underneath and around them ; hence, the action of the adductor muscles being no longer counterbalanced, the limb is drawn upwards and forwards, and turned inwards (Fig. 485).

Fig. 486. — Carious Head of Thigh-bone after Excision.

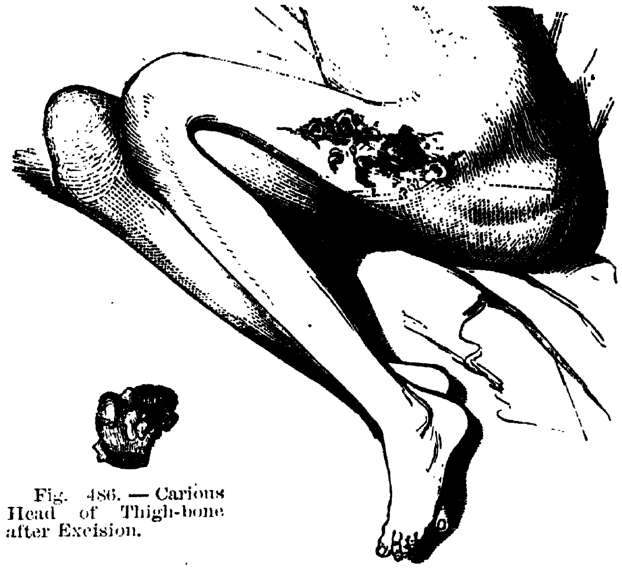


Fig. 485.—Chronic Disease of Hip-joint. Sinuses on outer side of Thigh.

The shortening of the limb may arise, in very chronic cases, from general atrophy of the member, consequent upon disuse ; and this, no doubt, in all instances after a time influences its condition. Most commonly, however, shortening occurs from absorption of the head of the bone, which is usually at the same time dislocated upon the dorsum of the ilium. In these cases, the remains of the dislocated head can be felt through the thin and weakened muscles in its new situation, and in other instances may be found lying at the bottom of a cavity in a carious state (Fig. 486).

Prognosis of Hip-Joint Disease.—The prognosis in cases of diseased hip must be regarded from two points of view—1, as concerns the Life of the Patient ; 2, as to the Utility of the Limb that will be left.

1. **Life.**—Disease of the hip-joint, and of the contiguous osseous structures, is dangerous to life in proportion to the abundance and the long continuance of the suppuration ; and this is dependent partly on the patient's constitution, but chiefly, and in the first degree, on the extent and nature of the osseous disease. In the *arthritic* form of coxalgia, suppuration is often prevented by rest and appropriate treatment ; and when this is the case, the patient will usually recover. If suppuration take place in cases of this kind, recovery need

not be despaired of; but convalescence will be greatly protracted. In such cases much will depend on the patient's constitution. If that be highly scrofulous, tuberculisation in other organs, more particularly in the lungs or spine, may probably take place, and destroy life.

When the bones that enter into the composition of and that surround the hip-joint are diseased, the case at once assumes a much graver aspect. Some Surgeons are of opinion, that if caries exist the patient must die. In this doctrine I cannot concur. I believe that much will depend on the situation and extent of the caries, and on the question whether it be primary and tuberculous, or secondary to disease of the soft joint-structures. In the latter case the head of the bone, denuded of its incrusting cartilage, softened and carious upon the surface, may be thrown on to the dorsum ilii; profuse and long-continued suppuration will ensue, yet, under good and careful management, and without operation, I have in some instances seen recovery take place.

In those cases in which the disease is primarily *femoral*, and dependent upon tubercular deposit in the head of the thigh-bone, the prognosis, if the case be not subjected to operation, is very unfavourable. Here we have a form of caries in which there is no prospect of spontaneous cure; and the patient will be worn out by hectic, induced by the long-continued and irremediable suppuration resulting from the irritation excited by the dislocated and carious femoral head in the gluteal region.

The condition of the *pelvic bones* is one that more materially than any one other circumstance influences the prognosis in cases of coxalgia. When the acetabulum alone of these bones is affected, the prognosis will turn upon whether this acetabular disease be primary or secondary. If it be *primary*, intrapelvic abscess will probably form, pointing above Poupart's ligament; and whether the head of the thigh-bone be dislocated or not, I believe that death must necessarily ensue, unless the diseased osseous structures be excised. If it be *secondary* to disease of the head of the thigh-bone, in which the primary mischief has developed, the condition of the acetabulum need not seriously affect the prognosis. In these cases the head of the bone becomes dislocated, and this very displacement is the first step towards the cure of the disease in the acetabulum. The surface of this cavity, which is roughened, and deprived of its incrusting cartilage, speedily becomes covered by granulations. These undergo fibroid transformation; and in the course of a short time the whole cavity becomes filled up by a dense elastic fibroid growth, which is in fact the medium of repair of the diseased and disused acetabular cavity.

When the morbid action extends to the osseous structures around the acetabulum, such as the rami of the ischium and pubes, the body and the tuberosity of the ischium and the upper lip of the acetabulum, and even the dorsum of the ilium, the disease usually partakes more of the nature of necrosis than of caries, and is perfectly incurable, except by operation. In extensive pelvic disease such as this, natural means are quite unable to effect a cure, and the patient must die of hectic or intercurrent disease, unless recourse be had to excision of the head of the thigh-bone and the whole of the necrosed and carious osseous structures.

2. **Utility of the Limb.**—When once the hip-joint has become inflamed, more or less lameness will invariably result, however carefully conducted the treatment may be. The amount of lameness may consist in a mere stiffness about the hip, a difficulty in abduction, in flexion of the thigh on the pelvis, or in free rotation : or it may extend to absolute uselessness of the shortened, withered, and deformed limb, which hangs powerless from the pelvis, suspended as it were by the ilio-femoral ligament, and slightly flexed and adducted. The extent of lameness will depend chiefly upon the form of the disease, and to some extent upon the treatment adopted ; but some will ever be left. When the coxalgia is *arthritic*, and suppuration has not taken place, ankylosis of a more or less complete form will usually ensue ; and if the thigh have been kept in the straight position, a sufficiently useful limb will be left, but slightly shortened, and possessing free compensating movement in the lumbar spine, enabling the patient to swing it with facility as he walks. If suppuration have taken place, and the head of the bone have been absorbed or dislocated, the limb, even under the most judicious treatment, will be left considerably shortened, weakened, wasted, and more or less adducted, with the knee carried somewhat forwards, as well as inwards, and the patient walking often most imperfectly and with great difficulty on the points of his toes.

Diagnosis.—In making the diagnosis of coxalgia, care must be taken not to confound it in its early stages with an ordinary attack of *rheumatism*, a mistake that not unfrequently happens. The alteration in the shape and position of the limb, the obliteration of the fold of the nates, and the limitation of the pain to one joint, will usually prevent the Surgeon from falling into this error. With *disease of the knee*, care must be taken not to confound hip-disease, in consequence of the pain in the early stages being commonly referred to the former joint ; here the absence of any positive sign of disease about the knee, and the existence of all the signs of disease in the hip that have already been noticed, will enable the Surgeon to diagnose the true seat of the affection. *Lateral curvature of the spine*, accompanied by neuralgic tenderness in the hip, occasionally gives rise to apparent shortening of the limb with pain and rigidity ; but in these cases the existence of the spinal affection, the superficial nature of the pain, and the absence of increase of suffering when the joint is firmly compressed, or of painful startings at night, will indicate the true nature of the affection. *Abscess* may occasionally, though rarely, form in the vicinity of the hip without that joint being diseased. Should this take place towards the anterior aspect of the articulation under the pectineus muscle, it may, by its pressure upon the obturator nerve, occasion pain in the thigh and knee, as in those cases in which the articulation is affected ; here, however, the sound state of the joint at its posterior and outer part, the absence of all obliquity of the pelvis, and of the other signs of the true hip-disease, will enable the diagnosis to be effected. The diagnosis from *sacro-iliac disease* has been described at p. 307.

Treatment.—The treatment of disease of the hip must be conducted with reference to the form of the disease, the acuteness of the attack, and the severity of the local and constitutional symptoms. In all cases, this affection must be managed in accordance with those general principles that guide us in the treatment of inflamed joints.

It is of especial importance to adopt early measures. If we wish to prevent the occurrence of suppuration, dislocation, or ankylosis, the child must, on the supervention of the *earliest* symptoms of impending mischief about the joint, be put under proper constitutional treatment, and complete rest of the limb must be secured by a well-fitting leather splint. By early attention, a cure may be effected ; whereas, if the case be neglected in its first stages, the utmost the Surgeon can do is to save the life of the patient ; the limb invariably falling into a shortened, withered, and distorted condition.

When the disease is of the acute **Arthritic** kind, the patient must of course be kept in bed, and absolutely at rest, and be treated with calomel and opium freely administered, having a full dose of an opiate at night, in order to prevent the painful startings of the limb. The inflamed joint must be comfortably arranged upon pillows, so as to be kept in as easy a position as possible ; and great relief will be afforded to the patient by the application of hot poppy-fomentations. But no treatment will be of the slightest avail, unless we adhere rigidly to that principle which is paramount in the management of all acutely inflamed joints—absolute rest. In inflammation of the hip-joint, there are two methods of securing this : 1, by means of a weight attached to the limb ; 2, by the long splint. Of the two methods, that by a weight is the best, as it enables the Surgeon to make any necessary application to the hip without disturbing the apparatus. In applying extension by means of a weight, the following plan should be adopted (Fig. 487). The patient is placed on a hard mattress. The pelvis and body are fixed to the bed by means of broad felt straps and buckles.

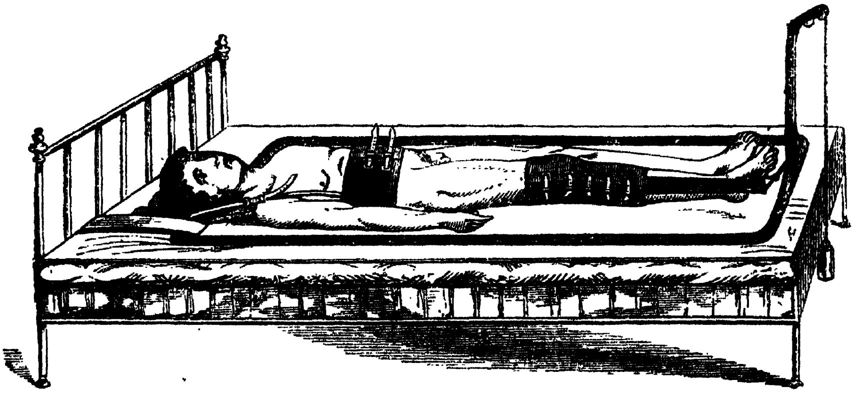


Fig. 487.—Apparatus for Extension by Weights in Hip-joint Disease.

A leather ankle-strap is then placed round the foot and lower part of the leg, and a padded belt above the knee. From the sides of each of these, straps are carried to a point six or eight inches beyond the foot, where they are attached to a transverse iron rod, four inches long. From this the cord suspending the weight passes over a pulley-frame fixed to the end of the bed. The weight applied should be from two to three pounds in children up to six years of age ; four pounds between the ages of six and ten ; five or six pounds from ten to thirty. If the long splint be used, it must be applied as for fractured thigh, but without the perineal band. When the inflammatory action has been somewhat subdued, the joint may be conveniently fixed by means of a leather splint or the starched bandage. Of the two I prefer the starched bandage, as being more easily applied, and forming a better fitting and more secure casing to the limb. In applying it, the limb should be bandaged from the toes upwards, and well padded about the knee with cotton wadding, and the bandage should be carried in repeated turns round the hip and body in the form of a spica; at the posterior part of the hip it should be strengthened with a piece of pasteboard lined with calico, sufficiently long to extend down the whole of the back of the thigh to below the knee, so as to support that joint also. It is of much importance to do this, as otherwise the hip cannot be kept immovable. In applying this, or any other apparatus, in the more acute form of the disease, the patient will commonly require to have chloroform administered, as the pain occasioned by the necessary movements would otherwise be too severe to be borne. After the starched bandage has well set, a trap may be cut in it opposite any part of the joint to which it may be thought necessary to make applications; and the perineal aspect of the apparatus must be well lined and covered with oiled silk, so as to prevent its being injuriously soiled. In this way the limb may be immovably fixed in a proper position by a light and firm apparatus, which will seldom require to be changed during the treatment of the case.

A very ingenious and useful extending apparatus for hip-joint disease, at any period of its development, from the earliest to that of abscess, has been invented by Sayre (see Fig. 488). By means of this apparatus, extension is made from the knee, and counter-extension from the pelvis, the apparatus being lengthened by a rack and pinion on the outer bar. It prevents the necessity of confinement to bed, and keeps the limb in a straight position.

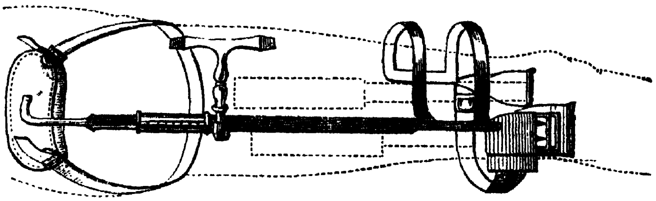


Fig. 488.—Sayre's Extending Apparatus for Hip-joint Disease.

The best apparatus that has yet been invented for hip-disease is that represented (Fig. 489) by H. O. Thomas. The patient is laid in the splint; the limb speedily falls into a straight position, and having been fixed, exercise may be allowed, the patient walking on crutches, with a patten, to raise the sound foot, and so carry the diseased limb well off the ground. The contrivance is a most admirable and useful one.

When the disease has fallen into a somewhat chronic condition, or has been from the first of the subacute or **Femoral** variety, a different and less active line of treatment requires to be pursued. In such cases, rest and perfect immobility, by means of the starched bandage or leather splint, are indispensable; in conjunction with these, the employment of counter-irritants more particularly the caustic issue, will be attended with great advantage; the issues may readily be applied through traps, cut in the apparatus behind the trochanter, and at the forepart of the joint opposite the pectineus muscle. At the same time, a course of moderate alteratives and tonics conjoined will be found most advantageous. To children, a powder composed of a grain of mercury and chalk, two grains of carbonate of soda, and three of rhubarb, with or without half a grain of quinine, may be administered twice a day. For adults, the bichloride of mercury in small doses, with sarsaparilla or bark, will be found most useful. This alterative plan must be persevered in for a sufficient length of time; and, as the symptoms of inflammatory action subside, and those of strumous disease manifest themselves more unequivocally, cod-liver oil, with the iodide of potassium or of iron, may be advantageously substituted.

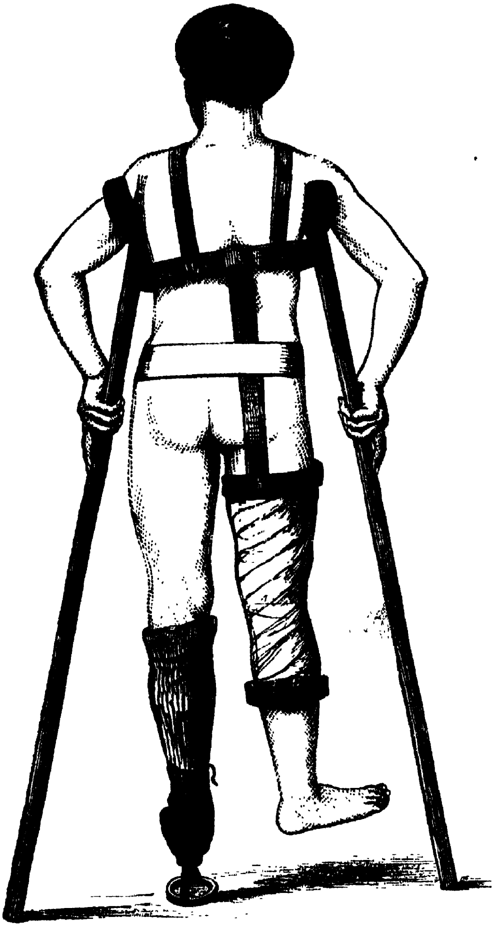


Fig. 489.—Thomas's Hip-Apparatus.

During the whole of the treatment, the general health requires careful supervision. The diet must be attended to, and should be as nutritious as possible; the state of the bowels regulated; the skin kept in good action with a flesh-brush; and the patient should reside in well-ventilated apartments. It will very generally be found that the liver is peculiarly apt to get out of order in this disease, the patient becoming jaundiced and feverish; this complication must be treated on general principles. As the health improves, a change to the seaside will be attended with great advantage; and the patient may be allowed to move about on crutches, having the foot suspended in a sling, as in the case of fractured thigh. In such circumstances, the best result that can usually be looked for is a stiff joint; but, even if this form, the patient's condition will be far from unfavourable, for the want of movement in the hip becomes counterbalanced by the greatly increased mobility of the lumbar vertebræ, enabling the patient freely to rotate the pelvis.

As abscesses form, they should be opened early; no good results from delaying to give exit to the pus, which only spreads more widely, disorganising the soft structures. Means should be taken, by tonic remedies and nourishing food, to keep off hectic. If dislocation have taken place, and the limb consequently have become a good deal shortened or deformed, being perhaps adducted and inverted so far as to be twisted over the other, or drawn up upon the abdomen, much may be done to lessen the deformity by putting the patient under chloroform, bringing down the limb, and fixing it in a starched bandage. Ankylosis in a good position may thus be sometimes obtained, and the patient's condition be greatly improved. It is a question whether an attempt at reduction should be made in these cases of consecutive dislocation, as it is very rarely that it would prove permanently successful, the acetabulum being either filled up with fibrous matter, or the head of the bone so diseased and lessened in size, that it would not remain in its cavity when put back. Occasionally, however, reduction may be successfully effected. In a woman under my care at the Hospital, with spontaneous dislocation of the hip of about a month's duration, reduction was effected by means of the pulleys, and the head of the bone replaced in the cotyloid cavity, where it remained for some weeks; becoming, however, displaced again in consequence of its being necessary to remove a bandage that was applied, as she became affected with inflammation of the chest, and could not bear its pressure. If ankylosis be likely to occur, the Surgeon must endeavour to secure it with the limb in a straight position; otherwise great inconvenience to the patient may result, especially if it occur in the position represented in Fig. 495. After a stiff joint has formed, the mobility of the lumbar vertebræ, and more particularly of the lumbo-sacral articulation, will be found to be greatly increased: so that at last the patient will walk with little inconvenience, rotating the pelvis on them. If the ankylosis be not osseous, but the result of the *arthritic* form of the disease, and especially if the head of the bone be still in the acetabulum, the limb may be straightened by forcible extension and rotation under chloroform, and the heel thus brought to the ground.

### EXCISION OF THE HEAD OF THE THIGH-BONE AND OF THE HIP-JOINT.

White of Manchester, in 1769, was the first to propose, and Anthony White, of the Westminster Hospital, in 1821, was the first to perform, excision of the head of the femur. This he did on a boy eight years old, who had had disease of the hip-joint for three or four years, and in whom the carious head of the thigh-bone rested on the dorsum ilii. White removed the head and trochanters of the bone, and the patient recovered from the operation, dying of phthisis five years afterwards. The preparation is in the Museum of the College of Surgeons. This operation was repeated by Hewson of Dublin, in 1823; and then seems to have been forgotten in Great Britain until its revival, in 1845, by Fergusson. But in the meanwhile it had not entirely escaped the attention of continental Surgeons. Oppenheim, in 1829, and Seutin, in 1832, excised the head of the femur for gun-shot injury; and, in 1842, Textor published an essay on the subject. Since the operation was revived by Fergusson, in 1845, it has been frequently performed, and may now be looked upon, notwithstanding the violence with which it has been assailed, as being an established surgical procedure in appropriate cases.

**Cases requiring Operation.**—Diseases of and about the hip-joint may, so far as the question of operation is concerned, be divided into two great classes—those in which no suppuration takes place, however acute the inflammation may have been; and those in which abscess forms.

To the first class belongs the **arthritic** variety of the disease, in which the synovial membrane and cartilages are primarily affected. In this form of coxalgia, the patient commonly recovers with a stiffened or even completely ankylosed, though useful and straight limb, dislocation of the head of the bone not having occurred. In such cases, I believe that excision is never needed; at least, I have never had occasion to do it, nor have I ever seen a case that seemed to me to justify such a procedure.

The second class of cases—those in which abscess forms—are by far the most numerous. In the great majority of these, however, the head of the femur is the part primarily affected, and in these recovery will take place eventually, under properly conducted medico-surgical treatment. But the recovery in such cases is always so far incomplete that the limb is left much crippled, and often of but little utility. In cases of this kind, after years of suffering and confinement to bed, and after a hard struggle for existence, we find the unfortunate patient left eventually with a limb that is shortened to the extent of from two to four inches, wasted and adducted, with a projecting deformed hip seamed with cicatrices; the remains of the upper epiphysis of the thigh-bone being dislocated from the acetabulum, and adherent to the dorsum ilii by firm ankylosis. The limb is unable to support the body, and cannot be extended, nor can the sole of the foot be firmly planted on the ground; but the leg is to a certain extent useful in progression, the patient using it as a kind of paddle to push himself on with, as he limps on the point of the toes. In these cases it is interesting to observe how nature compensates for the loss of all abduction and rotatory power in the hip by giving an extremely increased degree of mobility to the lumbar vertebræ; so that the patient, in walking, swings the pelvis from these, and thus in a great degree makes up for the loss of the natural movements in the coxo-femoral articulation.

But though recovery takes place eventually, in the great majority of cases of coxalgia that have even advanced to suppuration, yet in some and not a few instances the patient's constitution becomes unequal to the drain imposed upon it, and fatal hectic eventually supervenes. This is the direct consequence of the wasting and exhausting influence of the long-continued discharge of pus from masses of carious or necrosed bone, too extensive or too deeply seated to be eliminated by the natural actions of the part. It is in such cases as these that conservative surgery steps in, and endeavours to save the patient's life by the removal of the morbid cause that keeps up the discharge which is wasting it away. The object here is simply to save life by the removal of diseased bone. For the same reason—the preservation of life from hectic—that the Surgeon amputates in an extreme case of suppurating disorganisation of the knee-joint, he excises in an extreme case of disorganisation of the osseous structures that enter into the formation of the hip-joint: amputation is here too formidable a proceeding to be undertaken, and yet the removal of the diseased bone, the irritation and suppuration from which is rapidly destroying the patient, is an imperative necessity. And here it is impossible not to be struck with the strange inconsistency of those Surgeons who, looking upon caries of the bones entering into the conformation of the hip-joint as necessarily fatal, yet condemn as improper the only means of saving the patient's life—viz., the excision of the diseased osseous structures —and blame others for performing an operation which has saved the lives of numerous patients affected by a disease which they themselves have declared to be incurable.

The **Femoral coxalgia** is that form of the disease that is most benefited by operation. In severe and extreme cases of this variety of hip-joint disease, the upper epiphysis of the thigh-bone will be found lying in a state of caries on the dorsum ilii, in a suppurating cavity, with sinuses leading down to it. The pelvic bones are sound; the acetabulum is filled by fibro-plastic matter of a reparative character, though possibly it may be slightly roughened and necrosed at one lip. The soft structures in the gluteal region are thinned and wasted; the limb is incurably shortened, atrophied, and adducted. In such cases as these, the patient will probably perish, if left to the unaided efforts of nature; or if he recover, after years of suffering, it will be with a limb shortened, deformed, and but little useful. Resection, being limited to the upper end of the thigh-bone, or at most to the roughened lip of the acetabulum as well, is an easy operation, removes the cause of the wasting discharges and hectic, and in no way increases the already existing shortening, as it is limited to that portion of diseased bone which is already lying above and behind the acetabulum, and which is affected by incurable caries of too extensive and deep-seated a character to disintegrate and crumble away in the discharges, so that a natural cure without operation could take place.

Excision of the head of the femur has hitherto been done almost exclusively in advanced cases of the disease; but Annandale advises that recourse be had to it in the earlier stages. In those cases of hip-disease in which signs of suppuration are present, he recommends that an antiseptic exploratory incision be made into the joint, and the head of the femur examined;—if found diseased, it should be removed by sawing though its neck. Should there be osseous disease beyond this in the acetabulum or in the femur, it must be cut away. Annandale is led to recommend early operation of the kind mentioned in cases of hip-disease in which signs of suppuration exist, by the consideration that the head of the femur is usually carious in these cases, and that its early removal is likely to check the further progress of the disease, and to leave the patient with an useful and movable limb.

In the **Acetabular Pelvic** form of coxalgia, the ultimate result is, I believe, inevitably fatal, if the disease be allowed to run its own course unchecked by operation. Large portions of the pelvic bones in and around the acetabulum—such as the ischium, the tuber and ramus of the ischium, the ramus of the pubes and the dorsum ilii—fall into a state of necrosis; that cavity becomes perforated (Fig. 490); and the head of the thigh-bone, still lying in it, becomes denuded of its cartilaginous investment, roughened and carious, as is well seen in the annexed drawing (Fig. 491), taken from a patient of mine who died of this form of the disease; or it may be dislocated in a carious state on to the dorsum ilii. Large abscesses, intra- as well as extra-pelvic, form, and the patient dies worn out by hectic; the natural efforts of the part being entirely unavailing to separate and to eliminate such large necrosed masses, deeply lying, and covered in by the upper end of the thigh-bone.

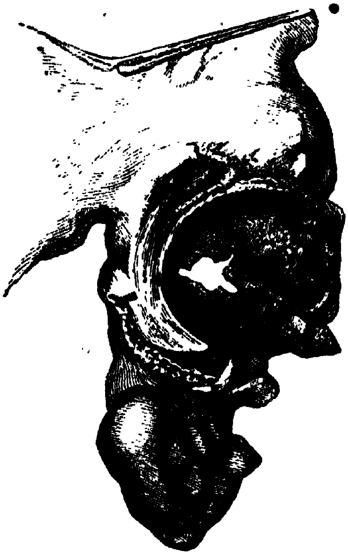


Fig. 490.—Perforation of the Pelvic Bones in Acetabular Coxalgia.

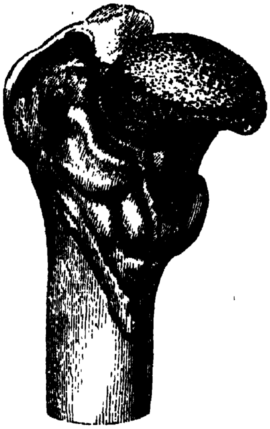


Fig. 491.—Carious Head of Thigh-bone in Acetabular Coxalgia.

**Removal of Diseased Acetabulum and Pelvic Bones.**—Until a very recent period, Surgeons feared to undertake the removal of large carious and necrosed portions of the pelvic bones, and acetabular disease of the hip-joint was accordingly allowed to run its fatal course unchecked. Hancock was the first Surgeon who undertook the removal of large portions of these bones, and since then the operation has been done several times by others. In no case has, I believe, more extensive disease been removed with a good result than in a girl who was sent to me some years ago by my friend Mr. Tweed, and from whom I removed the upper end of the thigh-bone, the acetabulum, the rami of the pubes and of the ischium, a portion of the tuber ischii, and part of the dorsum ilii. This patient, when admitted into the Hospital, was in the last stage of disease, exhausted by the constant discharge, and must inevitably have speedily sunk under the effects of the disease, had no effort been made to remove the cause of the prostration. At the operation, she was so exhausted that it was necessary to leave her on the operating-table for some hours before she was sufficiently restored to bear moving into bed. Nevertheless, by the free use of stimulants and nourishing food, she improved rapidly; and when she recovered the limb presented the appearance in the drawing (Fig. 492); it was straight, shortened about two inches; good movement existed at the hip; and she could walk with much ease. Constitutionally, she was in perfect health, and has continued so up to the present time, about fourteen years since the operation. In three other cases I have successfully removed large portions of the acetabulum and of the contiguous portions of the ilium and ischium. In cases such as these, the result, if they are left to themselves, must inevitably be fatal. There is no danger of laying open the pelvic cavity during the removal of these masses of pelvic bone; for, as Hancock has shown, during the progress of the disease the fasciæ, muscles, &c., lining the pelvis, become so thickened and infiltrated with plastic matter, that they form a barrier which effectually protects the pelvic cavity.

*Method of Operating.*—From the preceding considerations, it will be observed that there are two distinct operations practised on the coxo-femoral articulation. The first is simple resection of the epiphysis of the thigh-bone; the second, the removal of more or less of the acetabulum and of the contiguous pelvis bones as well. For the removal of the epiphysis of the thigh-bone only, the following plan should be pursued. The patient lies on the sound side. If the disease be femoral, the gluteal region perforated with sinuses, and the soft parts thinned, the head of the bone lying dislocated on the dorsum ilii, it suffices to pass a director down one of the chief sinuses leading to the carious bone, and to slit this up. If, however, the bone be more thickly covered, and be not easily reached with the probe, and if the sinuses open on the thigh at some considerable distance from the seat of disease, then a T-shaped incision should be made over the upper end of the thigh-bone, so as to expose it (Fig. 493). The limb should now be forcibly adducted, rotated

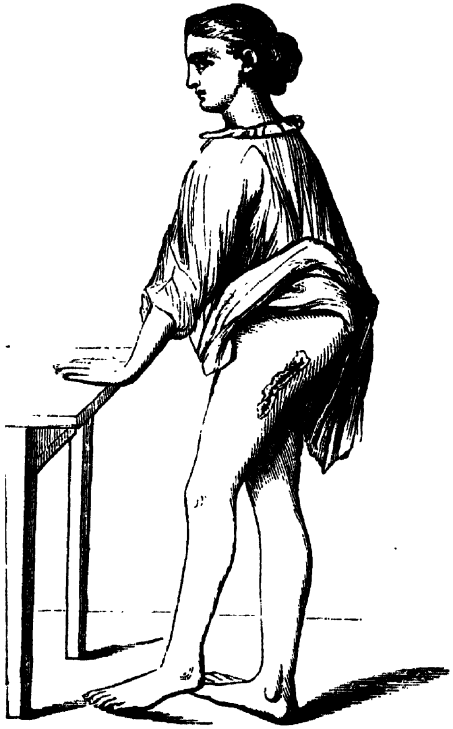


Fig. 492.—Result of Excision for Extensive Acetabular Coxalgia, three years after Operation.

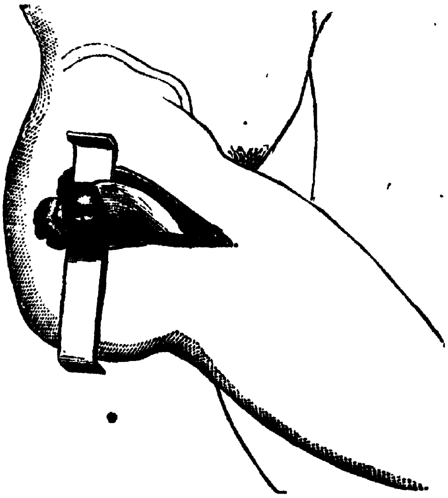


Fig. 493.—Excision in Femoral Coxalgia.

inwards, and pushed upwards by an assistant, and the soft structures separated by a probe-pointed knife from around the upper end of the bone, so that the whole amount of disease may come into view. The carious epiphysis is then cut off with a saw, the soft parts around being protected, if necessary, by means of retractors.

There is one practical question with regard to the amount of the upper end of the thigh-bone to be removed, which requires consideration; and that is, Should the bone be sawn through below the great trochanter; or through the neck only, leaving the trochanter? The practice should, I think, differ according to the nature of the disease. If this be femoral, it is best to take away the great trochanter, as the caries has generally reached its cancellous structure, or it may be infiltrated with tubercle. But if the disease be acetabular, and the pelvic bones be the parts most extensively and deeply affected, it will suffice to remove the head only, leaving the trochanter, which is not affected in these cases. After removing the head of the bone, the upper end should be examined, and any carious parts gouged out. After the epiphysis of the thigh-bone has been removed, the acetabulum must be examined, and any rough or necrosed bone lying at its edge should be gouged away.

In the acetabular form of the disease, where large portions of the pelvic bones require removal, the early stages of the operation require to be conducted in the way just described; the incisions, however, being made more freely, but not carried so far forwards as to endanger the anterior crural, or so far back as to wound the sciatic nerve. After the removal of the head of the thigh-bone, all loose necrosed pieces are to be taken out, and then, by means of ordinary cutting or gouge-forceps, the acetabulum and other carious osseous structures cut away piecemeal. Those portions of bone which have necrosed are usually separated, and lying loose, or else may generally be readily separated by the finger, or by the handle of a scalpel, from the subjacent soft structures; and the muscles and fasciæ lining the pelvic bones, being thickened and infiltrated with lymph, effectually protect the contained parts from all injury.

After the operation the wound must be dressed in a simple manner, and a long splint applied. Fergusson recommends that the extension should be made from the opposite thigh, round the upper part of which a socket is fixed, to which the band is attached (Fig. 494). Much advantage will be derived from the use of the bracket thigh-splint, from which extension may be made by means of a weight (as in Fig. 184, Vol. I.).

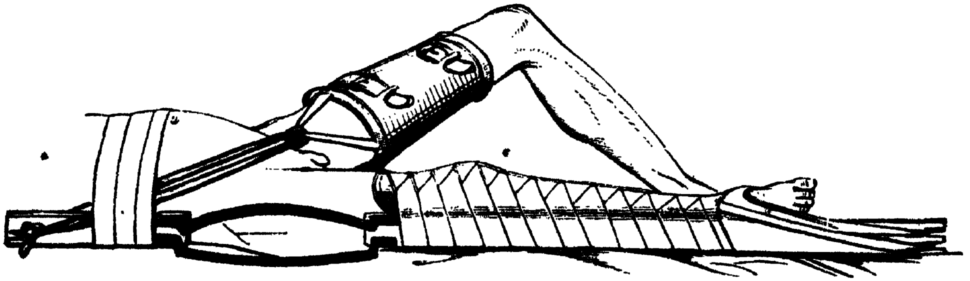


Fig. 494.—Apparatus to be used after Excision of Hip-joint.

*Results.*—The result of excision of the hip-joint has to be considered from two points of view :—1. So far as the Mortality immediately referable to the operation is concerned ; and 2. As to the Utility of the Limb that is left after its performance.

*Mortality after the Operation.*—Sayre of New York, in 1860, collected the statistics of 109 cases ; of these, recovery took place in 71, 36 died, and in two the result is noted as being unsatisfactory. Leisrink of Hamburg has published in the *Archiv für Klinische Chirurgie* (1870) the statistics of 176 cases. In 24 of these, or 13·6 per cent., death occurred from intercurrent diseases—mostly pyæmia (11) and septicæmia (2). Fourteen patients, or 8 per cent., died within a fortnight from exhaustion ; 14 others died between this time and the end of the first month—most from exhaustion, one from amyloid disease, and two from phthisis. From the beginning of the second month to the end of the year after the operation there were 27 deaths, or 15·3 per cent. ; while nine died in the course of two or more years, of phthisis and other diseases. Leisrink states that in 176 cases of excision of the hip, there were altogether 98 deaths. Of this apparently high mortality, however, only about one half, or 26 per cent. of the whole cases, can be ascribed to the operation itself, or to the intercurrence of pyæmia and other diseases which are liable to attend operative procedures. The other half of the deaths were produced by extension of the disease, by diarrhœa, or by phthisis or other disease of internal organs—probably in many instances existing at the time when the operation was performed. The mortality following the operation appears to have been much lower in England and America than in France and Germany.

The result of my own experience is, that the mortality directly referable to the operation itself is but small. I have operated in twelve cases. Of these, only two have proved directly fatal ; five are now well and going about ; three I have lost sight of, after their recovery and discharge from Hospital ; and two have died, one eleven months and the other two years after the operation, from constitutional disease unconnected with it. When we consider that all these cases were instances of advanced femoral or acetabular coxalgia, which would speedily have proved fatal if not subjected to operation, we may with justice look upon them as successful, so far as the preservation of life was concerned. And, in this respect, excision of the head of the thigh-bone or of the hip-joint stands in a different position from similar operations practised on other joints. The Surgeon excises the elbow, shoulder, or ankle, in order to restore an useful limb to the patient. Excision of these joints is a substitute for the loss of the limb by amputation—not, as in the case of the hip, to prevent the almost inevitable loss of the life of the patient by continuance of hectic.

2. In estimating the *utility of the limb left after the excision of the hip-joint*, we must compare it with the kind of member that would be left in the event of the patient surviving sufficiently long for a natural cure to result. It would be manifestly absurd to compare a limb which had become seriously crippled, withered, diseased, and shortened, before any operation was undertaken, with one in which no morbid action had ever taken place. So also would it be unjust to compare it with the state of a limb left after a slight attack of

coxalgia, in which operation could never have become necessary, nor have been contemplated. But, on comparing the result of operated cases with that of those which recover spontaneously, after caries and destructive disintegration of the upper epiphysis of the thigh-bone have existed for years, we shall find that the balance is by no means against those in which excision has been done. As I do not consider the operation necessary in cases of *arthritic* coxalgia, I do not compare the result of these cases with that of those operated on, but confine myself entirely to those in which there has been destructive bone-disease. In those rare cases of this description, when, after years of prolonged suffering, recovery is at last accomplished by natural means, the limb left is more or less completely ankylosed at the hip, wasted, shortened to the extent of two to four inches, partially flexed upon the pelvis, adducted, with the knee possibly stiffened, semiflexed, and advanced : the patient is just able to put the toes to the ground, without the power of bearing upon or rotating the limb, but, when he wishes to turn, twisting the whole pelvis by the aid of the greatly increased mobility of the lumbar spine.

After successful excision, the result is much more satisfactory, as may be seen in Fig. 492. The principal abnormal appearance in the limb is its shortening, to the extent usually of from two to three inches—to the extent, indeed, to which the pre-existing disorganisation and dislocation of the head of the bone had previously reduced it. It is well nourished, straight, firm, and admits of easy and rapid progression. The ankylosis is fibrous, not osseous. The patient is then enabled to flex the thigh on the pelvis, and to adduct it ; but, just as in cases that have undergone a natural cure, the power of external rotation and of abduction is lost, the mobility of the lumbar spine compensating for the loss of these movements.

**Caries of the Great Trochanter** occasionally occurs with abscess in the upper and outer part of the thigh, at first sight closely resembling hip-disease; but a little careful examination with the probe and by manipulation of the limb, will soon convince the Surgeon that the joint is free from disease, and that the morbid action is limited to the trochanter, and possibly the root of the neck of the thigh-bone. In such cases the diseased osseous structures may be successfully gouged away, after having been freely exposed by slitting up the sinuses leading to them. In such operations I have not only successfully removed the greater part of the trochanter, but have even scooped out a portion of the interior of the carious neck of the thigh-bone at its trochanteric end ; thus preventing the inevitable disorganisation of the hip-joint which would have resulted if the carious bone had been allowed to remain in close proximity to the articulation. In this operation the Surgeon necessarily comes into very close proximity with the capsule of the joint ; and unless great care be taken this may be opened, and thus the very mischief induced which the operation is undertaken to prevent.

In strumous children long sinuses will occasionally form about the great trochanter and gluteal region, leading to the supposition that there is caries of the bones in the vicinity of the hip-joint. The movements of the articulation will, however, be found to be perfectly free, and the most careful examination with the probe fails to detect osseous disease.

**Amputation in Cases of Disease of the Hip Joint.**—The question of amputation in cases of disease of the hip-joint is one that must often have presented itself to the Surgeon when he has contemplated the shortened, wasted, and deformed member that is frequently left in the more advanced form of the disease, and which can never be rendered useful as a basis of support to the body by any mechanical contrivance however skilfully designed, but must always remain not only an useless but a cumbrous appendage.

It appears to me that in the more advanced chronic cases of hip-joint disease, this operation is justifiable, and, indeed, is to be advocated in certain circumstances. These are as follow.

1. In cases where the disease is confined to the head of the femur, or where, if any portion of the pelvic bones be attacked, it be to so limited an extent as to be readily removable by the gouge, excision would necessarily be the usual practice. But if the patient's health be too low or irritable to bear this, or if the limb be so shortened, atrophied, and deformed by long disuse as to be incapable of furnishing proper support to the patient, then amputation at the hip-joint would, I think, be a proper procedure. I do not think that the mere destruction of the cartilaginous lining of the acetabulum should militate against the performance of the operation; for we constantly see in hip-joint disease when the head of the bone has been dislocated, or after amputation at the hip-joint for accident or ordinary disease, that the acetabulum fills up with a dense fibroid mass after the destruction or removal of its cartilage. But, if the pelvic bones be so far diseased that the necrosed or carious part does not admit of removal, then necessarily amputation would not be justifiable.

2. When the diseased action involves the shaft of the femur, which may be necrosed, or thinned and atrophied to such an extent and degree as not to leave a sound limb after removal of the upper epiphysis, amputation would be proper.

3. Amputation would be justifiable after excision has been tried and has failed in securing an useful result to the patient, the limb being left short, weak, loose, and œdematous.

## ANKYLOSIS OF THE HIP-JOINT.

*Ankylosis of the Hip-Joint*, following its inflammation, differs in its degree of completeness and in the position of the limb. Thus, it may be fibrous or osseous; or the limb in either of these cases may be straight, or more or less flexed on the abdomen and adducted.

The most important point in all these cases is the *direction of the limb*. If that be straight, so that the axes of the femur and of the trunk correspond, but little treatment is required, or indeed possible. When the head of the bone is completely ankylosed with the limb in this direction, the osseous structures of the head of the femur and of the acetabulum being fused together, absolutely nothing can be done to improve the patient's condition. The lumbar spine will acquire increased mobility, especially in a rotatory direction, and the patient will stand and walk with ease. The chief difficulty arising from the extended position of the limb will occur in mounting stairs and in sitting.

If, however, the ankylosis be not complete, but fibrous, even though the limb be straight, the freedom of movement may be much increased, and any faulty direction as to abduction or adduction may be in a great measure remedied, by douches, friction, pressure, or even forcible movement, and occasionally by the subcutaneous section of tense bands of fascia, or of tendinous and muscular structures about the anterior superior spine of the ilium.

If, unfortunately, the limb have become ankylosed in the flexed or angular position, means must be adopted to straighten it ; and this must be done whether the ankylosis be fibrous and incomplete, or osseous and complete. For here the deformity and inutility of the limb are always considerable ; and increasingly so, the more the ankylosis approaches to a right angle.

In rectangular ankylosis of the hip, the foot cannot be put to the ground so long as the spine is straight (Fig. 495). In order that the toe should touch the ground, it becomes necessary that the body be bent forward ; and the lumbar spine will consequently be thrown into a very considerable arch with the convexity forwards (Fig. 496).

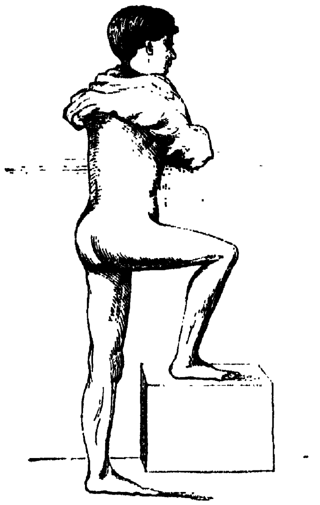


Fig. 495.—Ankylosis after Hip-joint Disease : Angular Flexion of Limb on Pelvis.

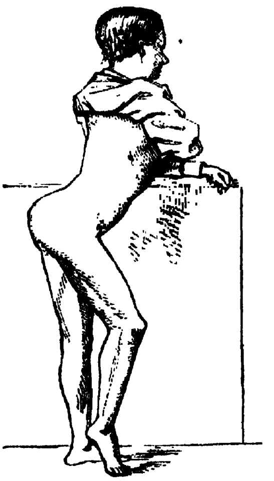


Fig. 496.—Ankylosis after Hip-joint Disease : Curvature of Spine in placing Foot on Ground.

The extent of the angular deformity in this kind of ankylosis can always be easily measured in the following way. If the patient be laid flat upon his back, so that the lumbar spine touches the mattress on which he is lying, the knee will be raised above that of the sound limb, and the angle formed between the thigh and trunk will be at once very perceptible. But if the knee be depressed so as to be brought to the same level as that of the sound limb, then the anterior superior space of the ilium is rotated forwards, and the lumbar spine arched forwards to an extent proportionate to the angle of deformity.

This angular ankylosis of the hip-joint requires to be corrected, and the limb to be brought into a straight position, so that, even if it be shortened, the patient may, by means of a high-heeled boot, rest it upon the ground, and use it as a means of support and of progression. This may usually be effected without much difficulty, when the ankylosis is fibrous, by forcible extension under chloroform, the limb being thus often brought straight at once without any material difficulty. But in other cases this cannot be done by simple extension, resistance being offered by the muscles on the anterior and upper part of the thigh. In such circumstances, those that offer most resistance must be divided subcutaneously; and these will usually be found to be the rectus, tensor vaginæ femoris, pectineus, and gracilis. After the limb has, in this way, been straightened, and maintained for some time in the straight position by means of the long splint or weight apparatus (Fig. 184), means may be adopted by passive motion and frictions to restore the mobility of the joint.

**Operation for Osseous Angular Ankylosis.**—When osseous ankylosis of the hip has occurred in the angular position, the case necessarily becomes much more serious; and the rectification of the position of the limb, and the restoration of its mobility, can only be effected by surgical operation.

The operation by which these objects are accomplished consists in the division of the Upper Part of the Femur; through its neck, if any remains of that structure still exist, or, at all events, above the trochanter minor.

The first operation of the kind was performed by Rhea Barton, in 1826. It was done in the case of a sailor, 21 years ago, who, in consequence of an injury, had an osseous ankylosis of the hip in a nearly rectangular position. Barton, according to Gross, made a crucial incision over and down to the great trochanter. The muscles were detached and turned aside, and the bone sawn through, the great trochanter and part of the neck of the femur having been divided transversely. Whether a simple section of the bone was made, or, in conformity with Barton's usual practice in ankylosis, a V-shaped piece of bone was removed, I know not, for on this point American authorities differ. But the limb was brought into a straight position, and put up in a fracture-apparatus for twenty days. At the end of this time, passive motion was commenced, and at the end of four months the patient had a movable false joint, so that he could rotate the limb, abduct it for twenty inches, and carry it backwards and forwards to a still greater extent. The case was therefore eminently successful. The operation appears, however, to have attracted but little notice, and to have been but rarely followed by others. It is true that Barton himself operated a second time; and that Rodgers of New York, in 1830, did so successfully on a man 47 years old. The example of these American Surgeons was followed in Europe, by Textor in 1841, and by Maisonneuve in 1847, on a girl of 18, successfully. Ross (U. S. A.) operated in 1857, on a woman of 23. In the two latter cases no false joint was made; but the bone, after being straightened, united again by callus. In March, 1869, I performed a similar operation at University College Hospital, on a girl of 16, who had rectangular osseous ankylosis of the right hip-joint. The patient made a slow but a good recovery with a straight and useful limb. There was no attempt at the formation of a false joint, but consolidation took place at the line of section.

The operation, having a double object in view, viz., the rectification of the position of the deformed limb, and the establishment of a mobile false joint near to the obliterated coxo-femoral articulation, was thus shown to be practicable; yet it had scarcely taken a place in surgical literature or practice, until Sayre of New York, in 1862, by performing it in two cases successfully, brought it prominently before the Profession, and has led to its establishment as a recognised operation for the remedying of these deformities. Sayre is undoubtedly entitled to the great merit of having established the operation on a distinct principle. His object was twofold; first, to go *above* the trochanter minor in the section of the bone, so as to retain the attachment of the psoas and iliacus muscles to the shaft for the purpose of flexion; and secondly, by cutting out a semicircular piece of bone, with its convexity upwards, and then rounding off the upper end of the lower fragment, more nearly to imitate the natural shape of the joint, for the purposes of motion and to prevent slipping of the bones. The accompanying Fig. 497, shows the situation and shape of Sayre's section, and of the piece of bone that he removes. The section of the bone is effected after its exposure, by means of the chain saw; the transverse section being first made, the convex one next (Fig. 498).

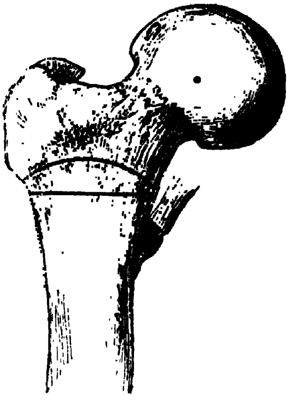


Fig. 497.—Lines of Section in Sayre's Operation for Ankylosis of Hip-joint.

W. Adams has devised a much more simple operation, having in view the same objects. His plan is to divide *subcutaneously* the neck of the thigh-bone about its centre. This idea he put in practice in December, 1869, when he performed the first subcutaneous section of the neck of the femur for the relief of deformity resulting from angular ankylosis. This operation is done as follows. The tenotome having been introduced a little above the top of the great trochanter, is carried straight down to the neck of the femur, dividing the muscles and opening the capsule freely. The knife being withdrawn, a saw of this size (Fig. 499), set in a strong angular handle, is passed down to the bone, which is cut through from before backwards (Fig. 500). The section of the bone takes a few minutes, and is as much an act of filing as of sawing. The wound is then closed by a pad, and the limb brought straight. Before this could be done in Adams's first case, it was necessary to divide the long head of the rectus, the adductor longus, and the tensor vaginæ femoris muscles. In performing this operation, as Adams justly observes, it is of great importance for the Surgeon to bear in mind the altered direction of the shaft of the femur, which is usually adducted as well as flexed forwards, so that the division of the neck may be made at right angles to the axis of the bone and not obliquely, or in a direction more or less parallel to the shaft. After the operation in Adams's first case, an endeavour was made by passive motion to

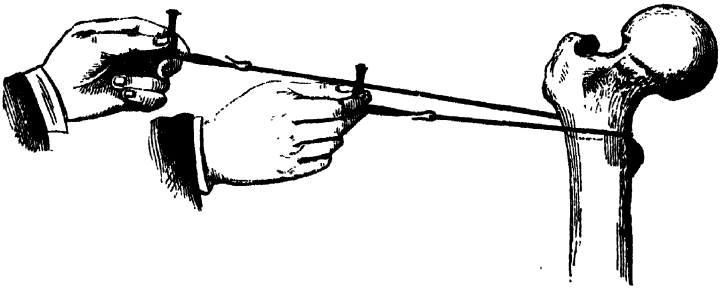


Fig. 498. Application of Chain Saw in Sayre's Operation.

get a false joint; but this being unsuccessful, the attempt was abandoned, and the limb allowed to ankylose in the straight position. Since this case, the operation has been repeated successfully by Adams and by many other Surgeons.

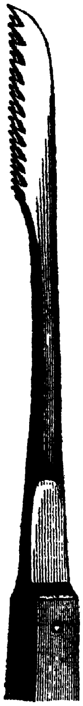


Fig. 499.—Saw used in Adams's Operation.

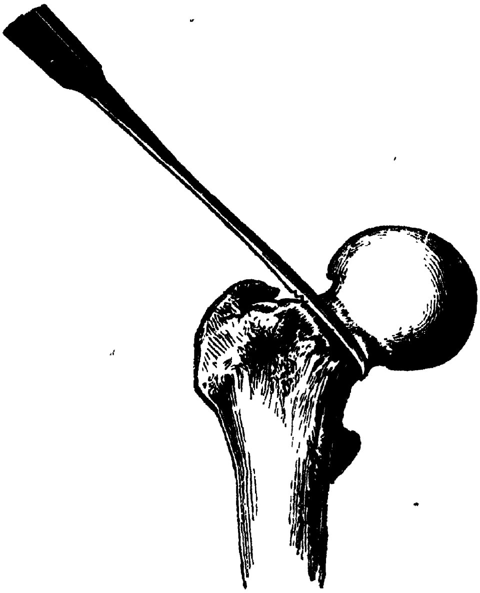


Fig. 500.—Application of Saw to Neck of Thigh-bone in Adams's Operation.

Maunder prefers a chisel to the saw in practising subcutaneous osteotomy of the neck of the femur, and has had much success in the operation so performed.

On comparing this operation with those which had preceded it, by Barton, Sayre, and others, there can be no doubt of its superior simplicity and safety; and although it is perhaps less likely to be followed by mobility of limb than when a piece of bone is cut out by Sayre's method, yet it must be admitted that not only is a movable false joint of doubtful utility, but it seems to have been very difficult of establishment, so great is the tendency to bony ankylosis after these sections.

# CHAPTER LIII.

# DISEASES OF SYNOVIAL MEMBRANES, AND OF MUSCLES.

## DISEASES OF BURSÆ.

The bursæ which naturally exist, either under the skin, beneath the muscles and ligaments, or around tendons, are subject to various diseases. Not only do the normal bursæ become affected, but these sacs are sometimes developed from continued friction in situations where they are not naturally met with, and here also they may undergo disease ; thus, for instance, bursæ have been found to be formed at the projecting point of a hump-back, on the prominent parts of club-feet, or at the extremity of stumps.

**Situations in which Bursæ exist.**—In the following situations bursæ naturally occur, and may consequently be expected to be met with in a diseased state :—behind the angle of the lower jaw, on the symphysis of the chin, on the angle of the thyroid cartilage ; on the acromion, the external and internal condyles of the humerus, the olecranon, the styloid processes of the ulna and radius ; on the dorsal surface of the metacarpo-phalangeal articulations, as well as on their palmar surface, and on the dorsal aspect of the phalangeal articulations ; on the anterior superior spine of the ilium, the great trochanter, the tuberosity of the ischium, the lower, superior, and outer parts of the patella ; on each condyle of the thigh-bone, the tuberosity of the tibia, the two malleoli, the calcaneum, the dorsal aspect of the toes, and on the plantar aspect of the heads of the first and fifth metatarsal bones. Besides these situations, they occur under the deltoid and the gluteus maximus, between the lower end of the scapula and the latissimus dorsi, and in the ham.

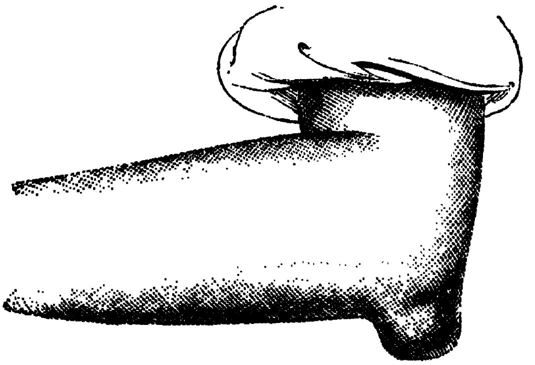


Fig. 501.—Enlarged Bursa over Olecranon—Miner's Elbow.

**Morbid Alterations.** — The continued irritation of bursæ by the pressure that is exercised upon them, may cause them to inflame, to enlarge, to become thickened, or to undergo various changes in structure. This enlargement of the bursæ in particular situations is often connected with special employments, by which continuous and severe pressure is exercised upon certain parts of the body; thus frequent kneeling will occasion enlargement of the bursa patellæ, hence called "housemaid's knee." Miners are occasionally subject to an enlargement of the bursa lying over the olecranon, hence called "miner's elbow" (Fig. 501); and in any situation a new bursa may be formed by continuous pressure and friction conjoined.

The four following pathological conditions may occur in the bursæ in any part of the body.

1. The bursa may, in consequence of continued pressure or irritation, become simply enlarged and filled by the excessive secretion of a clear sero-synovial straw-coloured fluid.

2. Inflammation may take place in the bursa with or without previous enlargement. The inflammation so set up speedily runs on to suppuration; and when the tumour is opened, fluid, consisting of an admixture of the bursal secretion and pus, escapes. The bursa, when its contents have suppurated, may either give way externally, pointing like an ordinary abscess, and the integuments covering it sloughing; or the pus may escape subcutaneously, and form a widely spread abscess around the part.

3. The enlarged bursa may contain a dark fluid, usually of a brownish colour, with a large number of small flattened elongated bodies, of about the size of grains of rice or of melon-seeds, floating in it. These bodies are of a fibroid or fibro-plastic structure, resembling masses of imperfectly developed exudation-cells, and are apparently portions of disintegrated lymph.

4. The walls of the bursa may gradually thicken by the deposit of lowly organised lymph in its interior, until the tumour becomes perfectly solid, or at most contains but a small cavity with a little serous fluid in its centre. The section of a bursa thus solidified presents a laminated or foliated appearance.

*Diagnosis.*—Enlarged bursæ are readily recognised; forming, whilst their contents are thin and serous, indolent oval tumours with distinct fluctuation, commonly occurring in the situation of some of the normal bursæ. As they become more solid they become elastic and hard, and often crackle on being pressed when they contain the rice-shaped bodies; but at last they acquire all the characters of an ordinary solid growth, as the deposition within them increases. Not unfrequently these enlarged bursæ inflame; or, indeed, an attack of inflammation in them may be the first cause of their enlargement. In either case they become hot and tense; the skin covering them is red, often doughy and œdematous; and although there is no connection between the bursa and the neighbouring joint, yet it may happen that the inflammatory action spreads to the latter, from simple continuity of tissue. Suppuration very frequently occurs in an inflamed bursa; the tension increases, the œdema and redness become more considerable, and the pain assumes a throbbing character. When the bursa is opened, thick pus, often mixed with shreds of sloughy tissue, is evacuated.

*Treatment.*—The treatment of these bursal tumours must depend entirely upon their nature and actual condition. When they are inflamed, rest, the application of leeches, followed by tepid lead-lotions or poultices, and general anti-inflammatory treatment, will commonly subdue the increased action.

If suppuration take place, they must be freely opened and the pus evacuated. When they are in an indolent condition, the Surgeon has the choice of various plans of treatment, conducted on different principles. If the sac be thin, the fluid of a serous character, and the disease recent, it may often be removed by blistering, more particularly when it occurs in the ham or under the deltoid muscle. In some cases it may conveniently be obliterated by puncturing the cyst, and then employing pressure upon it. The surest mode, however, of closing the sac consists in exciting inflammation in it, either by the injection of iodine as recommended by Velpeau, or by passing a small seton through it. The injection is readily effected by tapping the cyst with a moderate sized trocar, and then throwing in about a drachm of the compound tincture. Inflammation will be excited, some discharge will usually take place, and on its cessation the walls of the cyst will have become agglutinated together. In these cases I generally prefer, however, as the most certain method, the introduction of a seton composed of a double silk thread. This may conveniently be passed through the cannula after tapping the sac, in the way figured in page 153, Vol. I. (Fig. 77); a poultice should afterwards be applied, and the threads left in for about six days. Discharge will take place through the aperture by which they have been introduced, and which may, if necessary, be enlarged; the cyst gradually contracts around them, and after their removal it will be found to be closed. When the cyst contains a number of the rice-like bodies, the seton may still be used, but it should be thicker than that just recommended, and the aperture by which it is introduced should be very free, in order to allow the escape of the pus and granules.

If the walls of the cyst be very thick, or its contents semi-solid, or if the tumour have become solid, it must be dissected out. This operation is most commonly required for solid bursal tumours, situated over the patella or the tuberosities of the ischium; from both of these situations they may be removed with facility.

DISEASES OF THE BURSA PATELLÆ.—The exposed situation of the bursa patellæ, covered as it is only by the integumental structures and fascia lata, and its liability to pressure and irritation in kneeling, render it in all respects more prone to take on diseased action than any other similar structure in the human body; and the morbid conditions which it presents may be looked upon as typical to a great extent of the diseases of the bursæ generally.

The various affections to which the bursa is liable, may be divided into two classes: 1. Inflammatory Affections; and 2. Enlargements, of a Fluid or of a Solid character.

**1. Inflammatory Affections.**—This bursa is frequently the seat of *Simple Inflammation.* Undue pressure in kneeling upon a hard, irregular, and cold surface, such as stone, is likely to excite inflammation: hence its frequency in housemaids, whose occupation obliges them to kneel a great deal on floors and stone steps; and hence, also, the common title of "housemaid's knee," given to this and to many other affections of this bursa. But this disease, although frequent amongst housemaids, is not limited to them; for it occurs in females following other occupations, and in men as well as in women.

In simple inflammation, however occasioned, the bursa becomes rather suddenly swollen, tense, red, and hot, with some fluctuation deeply under the integuments. The swelling, heat, fluctuation, and redness, of a dusky colour, all situated in front of the patella, point out the nature of the affection.

The *Treatment* of this inflammation is simple enough. Leeches, followed by evaporating lotions, and keeping the patient at rest, are the means to be employed. Under this treatment, the disease will frequently undergo resolution in the course of a few days. It may, however, go on to suppuration, disease of the patella itself, or sloughing of the bursa.

*Suppuration of the Bursa* occurs in perhaps the majority of cases of inflammation. This is a matter of great consequence ; because the accumulation of pus, being of large size, and tending to diffuse itself around the knee-joint, is liable to be mistaken for abscess in that articulation. Sometimes it will point, and the pus discharge itself externally in the usual manner ; but very generally it gives way subcutaneously, and its contents speedily diffuse themselves somewhat widely around the joint beneath the fascia lata.

The history of the case affords the means of diagnosis. In suppuration of the bursa patellæ, the abscess commences by a superficial swelling and inflammation in front of the knee, which, after a time, extends laterally, enveloping the joint, the fluid gravitating on each side, but more especially on the outer one, nearly as far, perhaps, as the ham-strings. There will have been none of the signs indicative of acute arthritis accompanying the formation of this large abscess ; no startings of the limb, no laxity or pain in moving the articulation, no grating of the articular ends ; and little if any constitutional disturbance. The movements of flexion and extension of the joint are free up to a certain point, where they are checked by the mechanical obstacle of the purulent accumulation. But perhaps the most important diagnostic sign is the relation of the abscess to the patella. In a suppurating bursa, the patella is invisible, being covered by the fluctuating swelling ; in effusion, whether synovial or purulent, into the joint, the patella is above, floating upon the fluid.

The *Treatment* of this condition is simple enough. A free incision should be made through the anterior part of the bursa, so as to let out the pus mixed with synovial fluid ; and if there be any burrowing of matter, as there almost invariably is, counter-openings must be made in proper dependent situations.

**Disease of the Patella.**—Sometimes, but very rarely, abscess of the bursa patellæ will give rise to disease of the patella itself. Caries of this bone secondary to suppuration of the bursa, is, so far as my experience goes, exceedingly rare. I have seen one case of the kind—that of a woman who was in the Hospital, under my care, several years ago. When admitted, she had several fistulous openings on the fore part of the knee-joint, through which the probe led down to a rough and carious patella. On inquiry it was ascertained that she had had inflammation of the bursa patellæ—"housemaid's knee"—which had run on to suppuration, but that the abscess had never been freely laid open. The present condition had resulted from that suppuration. The joint itself was unaffected ; there was no pain in it, and its movements were perfectly free. I laid open the sinuses, and, finding the anterior surface of the patella soft and carious, removed with the gouge the diseased bone to which they led. About two or three weeks after this, the joint became suddenly swollen, evidently filled with pus, and the seat of acute pain. In consequence of the severity of the symptoms, it became necessary to remove the limb above the knee. After amputation, it was found that the morbid action had extended through the patellar cartilage, perforating it by a small aperture, and so giving rise to suppuration within the joint.

**Sloughing of the Bursa Patellæ** occasionally occurs as the result of its inflammation and suppuration. A woman was admitted into the Hospital, in whom this bursa had inflamed and suppurated ; and not only the bursa but also the integuments covering it had sloughed away, leaving in front of the knee a circular ulcer as large as the palm of the hand, having a flabby surface, and undermined, purple edges. The patella was not exposed. Under ordinary treatment, the ulcer slowly healed, but no vestige of bursa was left.

2. **Enlargements.**—We now proceed to the consideration of the second variety of disease of the bursa patellæ—that in which there is no inflammation, but in which there is enlargement of the bursa, owing to the accumulation within it of bursal fluid, of this fluid mixed with solid bodies, or of solid fibroid deposits.

*Simple Enlargement.*—The bursa may present a simple enlargement, dependent on the accumulation of fluid in its interior. Continued pressure exercised upon the bursa, as in kneeling, is the common cause of this affection ; hence it frequently occurs amongst housemaids, and constitutes the true "housemaid's knee." But it is also common amongst other people, whose vocation necessitates long-continued kneeling. One case of the affection in University College Hospital was in a carpet-layer ; it was to all intents and purposes a "housemaid's knee." A man, aged thirty, who, in consequence of habitually kneeling upon the left knee in laying down carpets, had a tumour there as large as an orange, indolent, soft, and fluctuating to the feel, evidently an enlarged bursa, was admitted into the Hospital. It was tapped by means of a trocar, clear fluid was drawn off, and a seton was passed through the cannula, and left in for six or seven days. Suppuration took place along the seton, the tumour collapsed and contracted, and the patient left the Hospital, cured, on the twelfth day.

With regard to the *Pathological Nature* of the disease, it would seem to consist in excessive secretion into the interior of the bursa, which becomes enlarged, thickened, and filled with a clear sero-synovial fluid.

The *Treatment* of these tumours is very simple. In some cases the application of tincture of iodine, or the ammoniacum and mercury plaster, or blistering, will succeed in inducing absorption of the contained fluid. If these fail, as they very often do, or if their use be too tedious, a very simple, and at the same time a very safe and successful, mode of treatment consists in tapping the tumour with the trocar, and passing a seton through the cannula, either by means of a long straight needle, or by using an eyed probe, and cutting down upon the end of it with a scalpel. The seton-threads should be left in until they excite free suppuration, and then be withdrawn. This treatment is exceedingly simple, and perfectly certain in its results. The only point to be attended to is, to keep the apertures by which the seton passes sufficiently patent to allow the free escape of any fluid which may collect in the interior of the bursa before it is closed. This is especially to be observed with the lower opening, which is apt to become blocked up.

*Chronic Enlargement.*—The next affection to which the bursa patellæ is liable is closely allied to the last, and appears to be an advanced degree of it. It consists in a chronic enlargement of the bursa, the coats of which are much thickened. The contents of the bursa, so enlarged, consist of a dark fluid, in which float a number of smooth oval bodies, of the size and shape of melon-seeds. I have seen this condition in both the male and the female. It may be distinguished from simple enlargement of the bursa, by the peculiar crackling sensation which is communicated to the hand when the tumour is manipulated. This arises from the melon-seed bodies floating about and rubbing against each other.

The *Pathology* of this affection is as follows. There is enlargement of the bursa, with excessive secretion into its interior of simple synovial fluid ; this, however, is dark-coloured, probably from admixture of blood which has undergone disintegration. This fluid will be found to contain a large quantity of cholesterine, broken-up blood-corpuscles, and granules. The melon-seed bodies are composed of lowly organised fibroid matter mixed with cholesterine, and are probably separated from the wall of the bursa.

**Solid Tumours** may be formed in connection with the bursa patellæ. By many these are supposed to be the result of a deposition of a fibroid material, which gradually takes the place of the fluid of an ordinary "housemaid's knee," and which, instead of taking the form of melon-seed bodies, is deposited in concentric masses, and thus accumulated in the interior of the cyst. This has not been the case, however, in many instances that I have seen. In these cases I believe there is a true fibroid deposit in the bursa from the very first ; the tumour is never fluid, but hard and solid from the commencement, and continues slowly to augment in size, until it occasions sufficient inconvenience to require removal. In some cases there has been a previous syphilitic taint ; the patient complains of pain in the tumour like that which is experienced in nodes, and it is by no means impossible that there may be a syphilitic origin for these tumours. However that may be, in the cases that have fallen under my observation, the tumours have never been fluid, nor have they originated in pressure, but appear to have been primary deposits of fibroid matter.

*Treatment.*—There is nothing to be done with such tumours but to dissect them out. This may be required in one or in both knees. With the most ordinary care the joint runs but little risk ; but much trouble may arise from opening up that layer of deep fascia which, after surrounding the knee, is fixed to the borders of the patella. Such an accident is liable to be followed by infiltration and deep abscess in the ham, and is to be avoided by keeping the scalpel well towards the centre of the patella when operating.

BUNION.—When the bursa which lies towards the plantar surface of the head of the metatarsal bone of the great toe becomes enlarged, or when a new serous sac is formed upon the inner and posterior aspect of this bone, the disease termed a *bunion* occurs. In this affection, the enlargement of the bursa is usually secondary to an alteration in the shape and position of the great toe, which in consequence of the pressure of narrow-pointed boots, has been thrown outwards in an oblique direction, so as to lie over or under some of the contiguous digits (Fig. 502) ; in this way a sharp angle is formed at the junction between the first phalanx and the metatarsal bone of the great toe. This angle, being constantly pressed upon by the boot, becomes irritated; and, for its protection, the bursa that is there naturally situated becomes enlarged, or an adventitious one forms. From time to time the bursa and the projecting angle become irritated and inflamed; and the morbid action thus set up may run on to suppuration of a very troublesome kind, a thin, unhealthy pus being formed, which is discharged through an opening that speedily becomes fistulous, and may degenerate into a most troublesome indolent sore.

*Treatment.*—In the treatment of this affection, the first thing to be done is to change the direction of the toe by wearing properly shaped boots, made with the inner side of the sole straight from the toe to the heel. If accidental inflammation be excited in the part, it must be allayed by the application of leeches, warm foot-baths, and poulticing; the cutaneous irritation that is left may best be removed by painting the surface with a strong solution of nitrate of silver. The faulty direction of the toe may best be remedied by using the ingenious contrivance (Fig. 503), the action of which consists in drawing the everted end of the toe inwards by the constant action of a slender steel spring. Should these means fail, the position of the toe may be remedied by the division of the external lateral ligament of the metatarso-phalangeal articulation, or of the tendon of the adductor pollicis, or of the inner head of the flexor brevis pollicis; the toe, when restored to its position, being for a time kept fixed upon an under-splint. Occasionally in elderly people the bunion will inflame and suppurate, and the mischief, extending to the metatarso-phalangeal articulation, will cause disorganisation of this. This is a state of things not devoid of anxiety, as it not unfrequently happens that, if the constitutional powers be enfeebled by age, a low sloughy erysipelatous inflammation may be set up in the foot, which eventually may terminate fatally. Should the joint be irretrievably disorganised, and the patient's strength admit it, amputation through the metatarsal bone should be done.

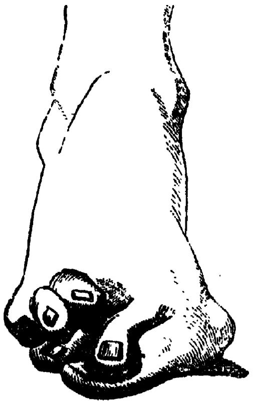


Fig. 502.—Distorted Foot, from Pressure and Bunion.

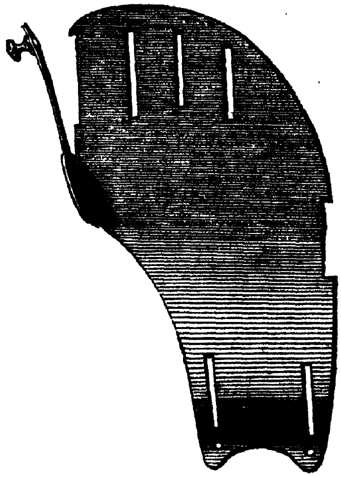


Fig. 503.—Apparatus for Deformity of Foot, as in Fig. 502.

## DISEASES OF SHEATHS OF TENDONS.

The synovial sacs connected with the sheaths of tendons are liable to two forms of disease: viz., the accumulating of the fluid in the interior of the sac, forming a cystic swelling, known by the name of Ganglion; and acute and chronic Inflammation, or Tenosynovitis. The tendons of the hand are most liable to both these affections.

GANGLION.—Two distinct kinds of ganglion are met with: the *Simple*, situated upon the sheaths of tendons; and the *Compound*, consisting in a dilatation of the sheath itself.

**Simple Ganglion** consists of a cyst varying in size from a cherry-stone to a large marble, and containing a clear transparent fluid of a yellowish colour, which is sometimes thin and serous, sometimes gelatinous and semi-coagulated. It occurs as a smooth, globular, elastic, and tense tumour, usually situated on the back of the wrist, where it forms a distinct round projection; it may also occur on the dorsum of the foot. In both situations it is distinctly connected with the sheaths of the extensor tendons; and, indeed, Paget looks upon it as being a cystic transformation of the cells enclosed in the fringe-like processes of synovial membrane lining these sheaths. As ganglion increases in size, it often gives rise to painful sensations in the parts below it, by pressing upon the neighbouring nerves; thus, a ganglion at the back of the wrist often produces pain and weakness in the hand, by compressing some of the branches of the musculo-spiral nerve which are stretched over it.

Ganglion is by far the most common of all the tumours that occur on the hand. In all cases of oval or rounded, smooth, elastic tumour on the hand or fingers, whether painless or neuralgic, the first point to determine is whether it be ganglion or not; but ganglion should always be suspected.

**Compound Ganglion** is chiefly met with in the palm of the hand, and the dorsum, sole, or inner side of the foot. It consists of a dilatation of the sheaths of the tendons in these situations: it may often attain a very considerable bulk, and then usually becomes irregular in shape, owing to several tendons being implicated by it. Often, in this form of ganglion, the sheath is thickened as well as dilated; and the contained fluid is clear and yellowish, though usually thinner than in the simple ganglion. The sheath itself is vascular, and lined by a red, fringed, and velvety membrane; the fluid may then be dark and bloody, and contain masses of buff-coloured fibrine or a large number of granular bodies, like those met with in certain forms of enlarged bursæ. These I have found to be composed of imperfectly developed granulations, in which the remains of blood-vessels were visible, probably thrown off from the inner wall of the vascular sheath. This form of the disease, at times, puts on almost a malignant appearance, is extremely chronic, and may occupy a very extensive surface; in a case that was under my care some time ago, the dorsum and greater part of the inner side of the foot were involved.

*Treatment.*—The treatment of a ganglion must depend upon its character and size. When small and simple, as on the back of the wrist, it may commonly be got rid of by being ruptured by forcible pressure with the thumb, or by a blow with the back of a book, or by being tightly compressed, by means of a coin wrapped up in a piece of lint and firmly strapped upon the swelling. If it do not disappear in this way, the best plan is to puncture it subcutaneously by means of a valvular opening, to squeeze out its contents, scarify the interior of the cyst, and employ pressure. If the ganglion give rise to much pain and weakness, and cannot be made to disappear by the use of the means just indicated, it may usually be very conveniently and safely obliterated by passing a seton of two threads through it, and leaving it in for four or five days, until sufficient inflammatory action has been induced for the obliteration of the cyst. Should these means fail, it may be dissected out, if it be thought advisable to have recourse to this somewhat severe procedure, which is attended with some risk of inflammation extending up the sheath of the tendon. I have, however, on several occasions performed this operation, without any troublesome consequences ensuing.

A **Ganglion situated in the Palm of the Hand,** and extending under the annular ligament some little distance up the flexor tendons of the forearm, is a very troublesome disease. Syme recommends that the cyst should be laid open, and the annular ligament divided. This seems to me an unnecessarily severe procedure; and I have in several instances cured the affection by milder means; in one, by injecting a small quantity of tincture of iodine into the cyst through a puncture in the palm, and in two or three other cases by the use of the seton. The seton is most easily introduced by squeezing the fluid from the palm into the sheaths of the flexor tendons above the wrist, making a puncture into these, and then pushing an eyed probe armed with two or three threads along the tendons under the annular ligament into the centre of the palm, where it is to be drawn out through a small incision made down upon it.

In the **Side and Sole of the Foot** these ganglionic tumours, when of large size, and filled with semi-solid fibrinous matter, may require to be dissected out.

INFLAMMATION OF THE SHEATHS OF TENDONS—TENOSYNOVITIS.—This is occasionally met with as the result of strains and twists of the hand, about the wrist, of the extensor tendons, or the long head of the biceps. In this affection there is swelling of a puffy character, with tenderness when the part is pressed on or moved; and usually a peculiar fine crackling sensation is communicated to the Surgeon's hand when he examines the affected part. The crackling is especially marked in cases in which the inflammation and effusion have become chronic, when the disease appears to partake of the nature of a diffused ganglion.

*Treatment.*—The treatment, when the disease is acute, consists in leeching and blistering, with rest of the part; when it has assumed a chronic character, the application of blisters and the mercury and ammoniacum plaster will be found most useful.

## DISEASES OF MUSCLES.

The voluntary muscles are not often the seat of primary disease of any kind. *Inflammatory affections* of a rheumatic character undoubtedly occur in muscles, and abscess is occasionally met with inside muscular sheaths, more particularly that of the rectus abdominis. *Syphilitic tumours,* or rather inflammatory or plastic indurations of muscles, are not very unfrequently met with.

TUMOURS OF MUSCLE.—Organic structural diseases of muscular tissue are rare; yet the records of surgery contain scattered through them no inconsiderable number of cases. Teevan, has, with much industry, collected the particulars of 62 cases of tumours of muscles of all kinds. About one-third of these are said to have been "cancerous;" 16 were "fibrous;" 8 cystic; 5 hydatid; and 5 erectile. In all probability, a more advanced pathology would have shown that many of the so-called cancerous and fibrous tumours were in reality sarcomata of various kinds. The form of cancer that occurs primarily in muscles is, I believe, invariably the encephaloid. I have most frequently seen the muscles of the lower extremity the seat of primary malignant disease. When the upper limbs are affected, the muscles that have, according to Teevan, been most frequently attacked are the pectoralis major, deltoid, and biceps. The muscles of the trunk and neck are seldom diseased, with the exception of the rectus abdominis, which appears to be very liable to tumours.

Of twelve consecutive cases that I have had under my care in which tumours of different kinds developed primarily in muscular tissue, the following are the particulars. The first case was that of a woman about 48 years of age, in whom a fibro-cystic tumour, as large as a cocoa-nut, developed in connection with the tensor vaginæ femoris, forming a large mass, which I dissected out readi from over the hip. The second case was that of a lad about 18, in whom cystic tumour, as large as a fœtal head, thick walled, and containing clear fd, developed in the substance of the adductor brevis of the thigh, from which was dissected out with no little difficulty, and with a fatal result. The third c was that of a man from whom the accompanying drawings are taken (Figs. 4, 505, 506), in whom a fibro-plastic tumour developed within the

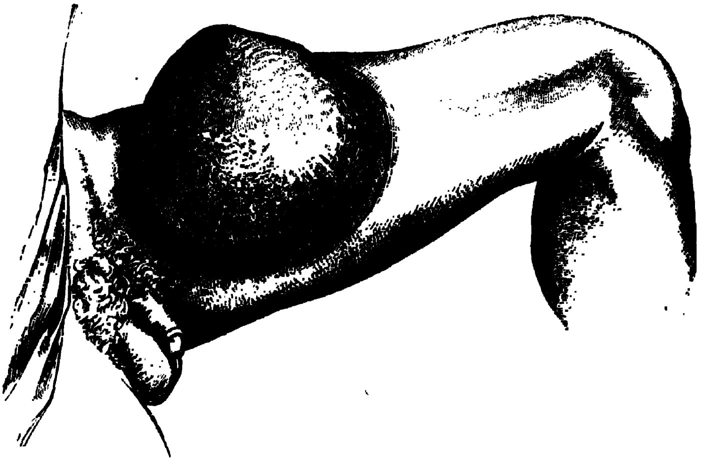


Fig. 504.—Fibro-Plastic Tumour of the Sartorius Muscle.

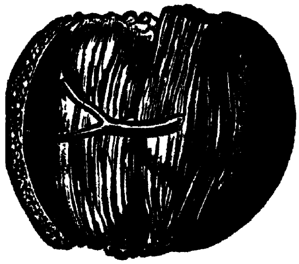


Fig. 5—Back View of Tumour, showing Sartorius Muscle.

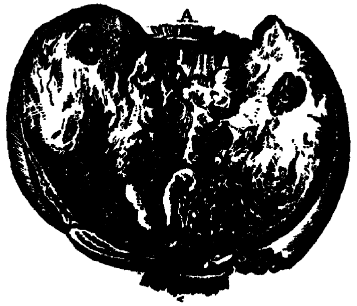


Fig. 506.—Front View of Tumour, laid open and showing Sartorius, A.

sheath of and in the substance of the sartorius muscle of the left thigh, in consequence of a strain. After growing slowly for about six years, it had attained the size of a child's head, when I removed it, together with seven or eight inches of the muscle from the inside of the sheath of which it had originated, and with which it was closely incorporated. The sheath of the femoral vessels, which was exposed for a considerable extent, was unaffected by the disease. Recurrence took place in less than twelve months in the cicatrix, and when the secondary tumour had attained the size of an ostrich's egg, it was removed, the patient making a good recovery ; but the disease again returned, and eventually proved fatal. The fourth case was that of a man aged about forty, in the sole of whose foot a cystic tumour, about as large as a goose's egg, was developed, springing from the flexor brevis digitorum. This was carefully dissected out ; but in a few months the patient returned, with a solid, elastic, rapidly growing tumour, evidently malignant, developed in the cicatrix (Fig. 507). The foot was amputated, and on dissection the mass proved to be encephaloid, and to have developed from the muscular structure just named (Fig. 508).

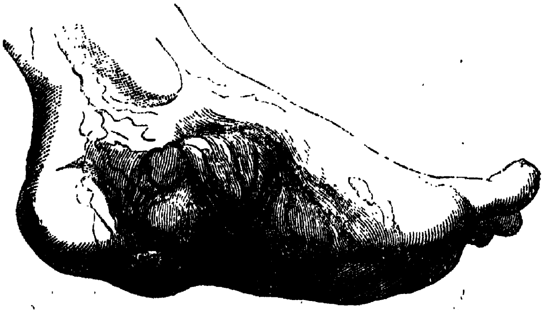


Fig. 507.—Malignant Tumour in Sole.

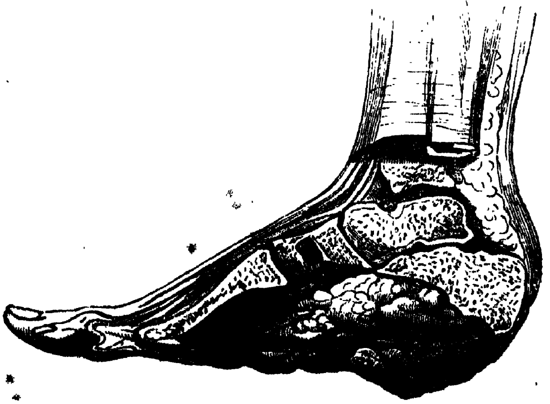


Fig. 508.—Section of Foot showing situation o umour.

In three cases the tumours were hydatid. In one patient, a young oman, the disease was seated in the deltoid; in the other, a medical man, out 50 years of age, the tumour was seated at the outer edge of the latissim dorsi ; and the third was a gentleman about 60 years old, in whose biceps t disease commenced. In each of these cases, excision of the tumour was s cessfully practised.

In the eighth case, the tumour was an enchondroma in the tibi anticus.

I have seen two other cases of enchondroma in muscles: one situated in the vastus externus of the thigh; the other in connection with the pectoral muscle. The ninth case was a sarcoma of the rectus femoris in a man aged 21, which I excised; the tenth, a cancerous growth in the anterior abdominal wall in an elderly gentleman; the eleventh, an encephaloid tumour of the muscles of the calf in a middle-aged lady, for which amputation was practised; and the twelfth, a sarcoma of the fore-arm in a lad.

Tumours developing primarily in the intermuscular areolar planes are of very common occurrence; but these are very different from, and must not be confounded with, true tumours of muscle.

The *Treatment* of these various muscular tumours must be considered on ordinary surgical principles. When of an innocent character, as cystic or hydatid, fibrous, erectile, or enchondromatous, they may be dissected out from the muscular tissue amongst which they lie, and no fear of recurrence need be entertained.

When they are malignant, amputation of the limb, if the tumour be favourably situated for such an operation, is generally the only resource: partial operations are usually worse than useless, as they lead to a speedy recurrence of the malignant action. Teevan has made the ingenious suggestion of applying to malignant tumours of muscle the same rule of practice that guides us in operations on bones affected by cancer; viz., to remove the whole of the organ that is the seat of disease, excising the entire muscle from its origin to its insertion, and thus eliminating from the system the whole of the morbid mass, which will be confined within its sheath—a structure that for a long time resists the outward pressure of a morbid growth. This suggestion is founded on correct pathological principles; the only objection to it is its difficulty of application in actual practice—there being few muscles so situated that they could with safety be completely extirpated.

# CHAPTER LIV.

## DEFORMITIES.

### LATERAL CURVATURE OF THE SPINE.

THIS affection, on account of the frequency of its occurrence and the tediousness of its cure, has received a good deal of attention from various Surgeons; and much has been written on it by those who have specially devoted themselves to its treatment; yet the whole of its pathology and management lie in a very narrow compass.

Lateral curvature of the spine most commonly commences at an early period of life, usually between the ages of twelve and eighteen—seldom before the one, and not very commonly after the other. Girls are more frequently the subjects of this deformity, which but rarely occurs in boys. It appears to consist simply in a relaxation of the muscles and ligaments of the spine; in consequence of which the vertebral column, being no longer able to support the weight of the head, neck, and shoulders, becomes curved to one side, a corresponding deviation taking place in the opposite direction at a lower portion of the spine, in order to preserve the equilibrium between the two sides of the body (Figs. 509, 510). The first curve usually takes place in the upper or

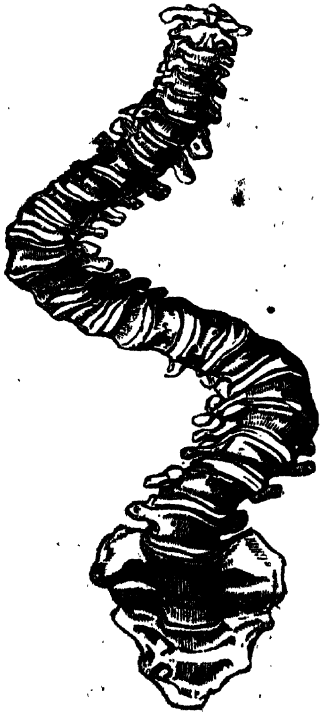


Fig. 509.—Lateral Curvature and Rotation of Spine.

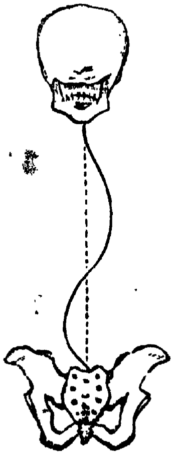


Fig. 510.—Outline of Double Lateral Curvature.

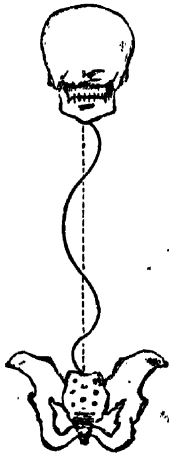


Fig. 511.—Quadruple Curve.

middle dorsal region, the convexity tending towards the right side; the second, or compensating curve, occurs in the lumbar region, the convexity looking towards the left. In some instances there is a quadruple curve (Fig. 511). At the same time that these lateral curves take place, there is a tendency to rotation of the bones of the spine upon one another, in such a way that the bodies of the vertebræ forming the dorsal curve are twisted slightly to the right, while those which enter into the formation of the lumbar curve are turned slightly to the left (Fig. 510). This twist is sometimes slight; but in other instances it is very marked, so that there is a double displacement—lateral and rotatory.

On examining the bones and intervertebral fibro-cartilages after death, even in cases of very considerable distortion, no disease will appear in them; except, perhaps, that the bodies of some may have been slightly compressed where they form the principal concavity of the arch. The ligaments appear to be stretched, relaxed, and somewhat weakened; and the muscles are usually pale, flabby, and apparently wanting in power.

MECHANISM.—From a consideration of the pathology of this affection, and from the particular age at which it manifests itself, before the bones have become completely ossified, or the ligaments have acquired their due degree of rigidity, its mechanism becomes sufficiently apparent. The spinal column, being composed of a number of separate bones, possesses no firmness in itself, or power of self-support, but is maintained in the erect position by the close manner in which its separate elements are knit together by ligamentous and muscular structures, and by the way in which, when thus bound together as a whole, it is supported on each side by the strong mass of the erector spinæ muscles and their prolongations. The proper tension of these ligamentous supports and muscular masses is especially necessary for it to maintain the weight of the head and shoulders, which is thrown on the cervical and the upper portion of the dorsal spine. If, from any cause, the ligaments become relaxed, and the muscles lose their tension, or if the weight of the upper part of the body increase disproportionately to the augmentation in the strength of the ligaments and muscles that support the spine, the vertebral column will necessarily give way under the pressure to which it is subjected in a direct line from above downwards, and will consequently become curved. Most commonly, indeed almost invariably, this takes place in a lateral direction, the spine yielding more readily in this than in any other. In some rare cases, however, the lower portion of the cervical or the upper dorsal region will project backwards in an angular manner, constituting the disease termed **Cyphosis** (Fig. 512); and in other cases, of still less frequent occurrence, there may be incurvation of the spine in the dorso-lumbar region, giving rise to **Lordosis** (Fig. 513).

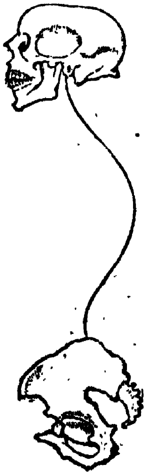
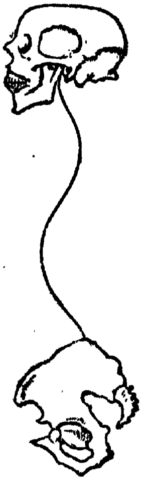


Fig. 512.—Cyphosis.



The directions in which these various curves take place are exaggerations of the natural inclination of the spinal column. In *lateral curvature,* the chief convexity takes place towards the right side, causing a projection of that shoulder which in most people is somewhat more prominent than the other. In *cyphosis,* the excurvation takes place in the lower cervical and upper dorsal regions, which are naturally prominent; and, in *lordosis,* the incurvation is most marked in the lumbar region, in which there is naturally a curve forwards.

CAUSES.—These various kinds of deformity, as has already been stated, chiefly occur in girls about the age of puberty; at a time of life when the tonicity of the muscular system not unfrequently becomes lessened by the occurrence of anæmia and those states of impaired health that so frequently attend the establishment of the uterine function; and before the osseous and ligamentous structures of the body are fully developed. At this period of life, also, it frequently happens that the spine becomes rather suddenly elongated by a rapid increase in growth; or that it becomes overweighted by the body developing itself, and the shoulders and bust becoming stout and expanded. Indeed, so frequent is the occurrence of a certain degree of lateral curvature of the spine from these various causes, about the age of puberty in girls, that few escape a tendency to deviation; of so slight a kind, however, as not to admit of recognition as a disease. But if this tendency be allowed to go on unchecked, or if it be increased by injurious habits, amongst which are all one-sided postures in which the body is twisted, as in playing some musical instruments, or in leaning over a table in drawing and writing, the slight deviation may rapidly increase until it assume the true characters of lateral curvature. I do not think that there is any evidence to show that this is either a strumous or a rickety affection; indeed, so far as my observation goes, I should certainly say that strumous girls are less liable to the disease than those of a nervous temperament. A rickety tendency would, of course, increase the disposition to the affection; but I think this is very rarely associated with it. Amongst the more common predisposing causes must undoubtedly be reckoned the indolent and sedentary occupations, and the luxurious enervating habits that are commonly encouraged in girls in the higher ranks of life, and which, by preventing due muscular development, at the same time that they induce a general loss of tone in the system, may directly occasion the disease. In growing lads, lateral curvature may be produced by a habitually maintained faulty position, as in writing at the desk, or in certain occupations. That the real cause of lateral curvature of the spine is to be found in faulty habits of life, and not in sex, is evidenced from the rarity of the affection amongst girls of the labouring class, as compared with the frequency amongst those of the wealthier orders of society. Who ever saw lateral curvature of the spine in a housemaid? It is in the drawing-room and not in the servants' hall that it is met with.

The causes of the antero-posterior curves are usually to be found in some faulty habits of the patient; either giving rise to an habitual stoop, and thus laying the foundation for cyphosis, or throwing too great a weight on the loins, and thus giving rise to lordosis. A kind of spurious lordosis is developed in some cases of ankylosis of the hip-joint.

SIGNS OF LATERAL CURVATURE.—The signs of this affection, when it is well marked, are distinctly obvious. The serpentine character of the curve, its double nature, the convexity on one side looking to the right shoulder, and on the other to the left loin, will render its nature evident. Most commonly it commences in a gradual manner, the first condition that frequently attracts attention being the prominence of the right scapula, which is supposed to be "growing out;" or the sterno-clavicular articulation on the same side, or some of the cartilages of the ribs, have been observed to project. Whenever the Surgeon is consulted for such symptoms, he should at once examine the spine, which he will generally find to have an inclination to the right side. In the early stages of the disease, when the deviation is not very distinctly marked, the readiest mode of determining it is to let the patient stand upright, taking care that the feet are well placed together, and that the attitude is not forced but natural; the Surgeon should then run his finger down the back from one spinous process to another, touching each as he passes it with a pen dipped in ink; in this way, when he has reached the lower part, he will have mapped out the course of the vertebral column, and thus may see at a glance the nature and extent of its displacement. At the same time, he will probably observe that the two hips do not exactly correspond, the left being somewhat thrown out. Very commonly there is a good deal of neuralgic tenderness about the spine, and at this early stage there may be anæmia and symptoms of impaired nutrition. As the disease advances, the curvature becomes more distinct, and at the same time, owing to the torsion of the column, assumes a slightly angular character where most convex. The ribs on the right side are thrown out and bulging, and carry up the scapula with them, whilst those on the left are sunk and depressed (Fig. 514). In fact, the whole of the right side of the chest and body partakes in the projection of the spine on that side, and thus adds much to the general deformity; whilst the left side of the chest is correspondingly hollowed and sunk in. When the disease has advanced in this way, it always occasions great general debility, emaciation, and pallor; the nutrition of the body being impaired, partly by the compression to which the thoracic and abdominal organs are subjected, and partly, doubtless, by irritation of the spinal cord induced by the curvature.

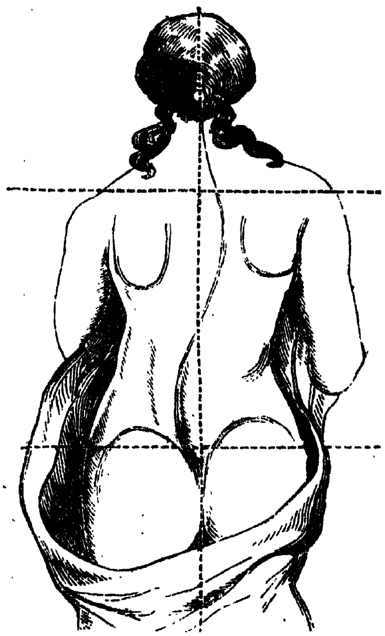


Fig. 514.—Lateral Curvature of Spine.

During the early part of the disease, the spine preserves its flexibility; and whilst the curve is still recent, and the patient young, if the weight of the head and shoulders be taken off, it will at once resume its straight direction. Thus, if the patient be lifted off the ground by raising her up with the hands under the axillæ, or if she be laid down on her face on a flat couch, the back will fall into a straight position, or may readily be made to do so by slight traction. After the disease, however, has existed for some years, or if the patient have passed that age at which consolidation of the bones and ligaments takes place, the distortion will continue permanently, in whatever position she may be placed. This is not only owing to the deformity of the spine, but to the ribs, and ligamentous and muscular structures generally of the trunk, having become fixed in their abnormal position.

TREATMENT.—The treatment of lateral curvature of the spine should be conducted on rational principles; and, when divested of the mystery with which some interested specialists have surrounded it, it becomes as simple as that of any other chronic surgical affection of the bones, joints, or muscles. There are three principles of treatment that require to be carried out in the management of these cases. The first is the improvement of the general health,—unless this be effected, nothing can be done; the second is, to strengthen the muscles of the spine; and the third, to take away as much as possible the weight of the head, neck, and upper extremities.

The administration of some of the milder preparations of iron, with a course of aloëtics for the regulation of the uterine function, is of great moment; at the same time, a nourishing diet of animal food should be allowed, and the patient encouraged to take exercise in the open air. By these means the nutrition of the system will be improved, and the tone of the muscles greatly restored. The muscular power may be more directly strengthened by having the back well sponged with cold salt or vinegar and water every morning, and methodically rubbed from top to bottom. The friction should be principally directed to the erector spinæ muscles on each side of the vertebral column, and may be done either with the naked hand, or with some slightly stimulating embrocation. At the same time, if the patient's strength will permit it, but not otherwise, the use of the hand-swing may be allowed, or calisthenic exercises practised; these, however, should not be continued if they induce a feeling of fatigue or exhaustion. Whilst this plan is being persevered in, the patient should be made to lie recumbent for a few hours daily, sitting or standing as little as possible. By these means, assiduously continued for some length of time, the muscles of the back may be strengthened, and the increase of the deformity prevented; and in this way the slighter cases of lateral curvature, those in which there is rather a tendency to than a full development of the disease, may be cured.

In slight cases of lateral curvature, great evils may be occasioned by the unnecessary employment of cumbersome machinery. The heavy apparatus that is often applied to growing girls overpowers and compresses, rather than supports and directs the imperfectly developed and still yielding skeleton. By the use of these complicated machines the muscles of the back become weakened and atrophied from disuse; the pelvis is compressed and contracted; and those very evils are produced by the mechanician which it is the object of the Surgeon to avert or correct.

When the affection is further advanced, though the spine still continue flexible, if there be decided projection of the ribs on one side, and the shoulder and hip be prominent, with apparent difference in the length of the limbs, and much impairment of the general health, more decided measures of treatment must be had recourse to. In these cases, as in those just described, the constitutional powers must be carefully attended to on ordinary medical principles; iron, and good living, with fresh air, being the basis of the treatment. At the same time that we endeavour to improve the strength of the system in this way, and that of the muscles of the back, especially by cold bathing and frictions, it is essential to adopt means to take off the weight of the head and shoulders, and to prevent its continuing to keep up and to increase the deformity. This may be done in two ways: by keeping the patient in the recumbent position, or by allowing her to go about, wearing proper supports.

The *recumbent position* in the treatment of lateral curvature of the spine, though a valuable means as an adjunct to other measures, has been greatly abused, by being employed as an exclusive plan. This should not be, except when the patient is unable to stand or walk with comfort, as happens in extreme cases, when it may be necessary to confine her for a time to this position, until the proper muscular power has been restored by other means. These instances, however, are very rare; too much so to constitute the rule in the treatment. Whenever the recumbent position is employed, the prone seems to me far preferable to the supine, for reasons mentioned when speaking of angular curvature of the spine (p. 300); and the best couch for the purpose is certainly Verral's. The patient should be kept on this during the intervals of exercise, not being allowed to sit or stand, even at meals; she will very soon become accustomed to a position that at first appears constrained, and will, probably, speedily be enabled to sleep in it.

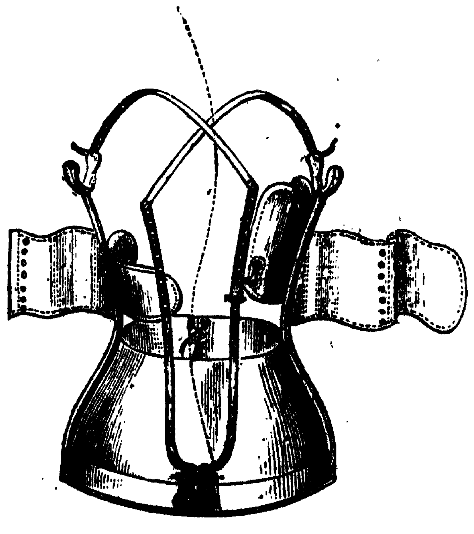


Fig. 515.—Spinal Support for Lateral Curvature.

The **Mechanical Contrivances** constructed for the purpose of taking the weight of the head, neck, and upper extremities off from the weakened spine, are of very various forms, and have had much ingenuity expended in their construction. They all have three principal objects, however much their details may vary; viz.: 1, to form a broad basis of support round the pelvis, by means of a strong well-fitting band; 2, to carry off the weight of the head and upper extremities from the spine by means of lateral crutches, whi transmit it to this band; and 3, influence the convexities of the spin curve by means of movable plat acted upon by rack-and-pinion or scr power. The best of these mechanic contrivances for supporting the weig of the head and shoulders, is the a paratus represented in the accompan ing woodcut (Fig. 515). By it tl projection of the right shoulder m be gradually brought down, the le one raised, and the weight of tl whole of the upper part of the boc supported. By this contrivance alone, properly and carefully adjusted to the condition of the deformity, most patients may be treated without the necessity of any confinement whatever: the spine being by degrees restored to its proper direction by very gradually increasing the pressure and support of the instrument, at the same time that the general health is carefully attended to, and the patient has the benefit of good air. At first the instrument need only be worn during the day, but after a time it should be kept on at night as well. In long-standing and severe cases of lateral curvature of the spine, when its flexibility is lost, and the projection of the ribs has become permanent, a cure cannot be expected, nor can it be brought about by any means; but the patient will derive great comfort and support from the use of this excellent instrument, and the increase of the disease may thus be prevented.

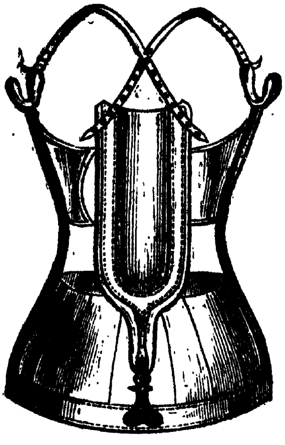


Fig. 516.—Spinal Support for Posterior Excurvation.

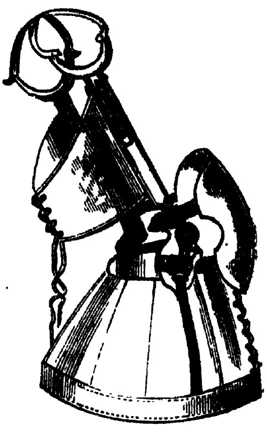


Fig. 517.—Spinal Support for Posterior Incurvation.

The treatment of *Posterior Excurvation* of the spine, without caries or other organic disease of the vertebral column, is best conducted by the use of the instrument here figured (Fig. 516), which is constructed essentially on the same principles as that for lateral curvature, with the exception that the back-plate is so arranged as to press upon the projecting spine, and thus gradually to bring it into proper position.

In *Posterior Incurvation* the apparatus here figured (Fig. 517) will be found the most useful appliance. In fact, all these varieties of spinal curvature may be successfully remedied by instruments constructed on the most simple mechanical principles, if carefully attended to and carried out.

### DEFORMITIES OF THE NECK AND LIMBS.

Various deformities, such as squint, wry-neck, and club-foot, are due to a disturbance of the normal equilibrium that exists between antagonistic muscles, so that, by the paralysis of one set, or by the spasmodic action of the other, the proper balance of power is lost, and the limb or part deviates from the position that is natural to it, being drawn down by the more powerful set of muscles. These deformities may be congenital, or they may be acquired.

The primary mischief is, in many cases, seated in the nervous system; in others, but more rarely, in the muscular. The ligaments and bones only become secondarily altered in shape, being shortened or compressed on the side towards which the limb or part inclines or is drawn. Fasciæ also become shortened and tense, and the disused muscles are apt to become soft, wasted, and flabby. The contracted muscle after a time becomes permanently rigid and shortened.

Causes.—The causes of these deformities are very various; but they may be referred to three heads.

1. **Continuous Faulty or Abnormal Position** of a limb, as in an unreduced dislocation or an ankylosed joint, will be followed by the disuse of a

certain set of muscles, which consequently become shortened and atrophied, and acquire a rigid state. This condition is consecutive to the displacement, but renders it permanent; it is apt to occur after fractures, if the parts be kept for too long a time in one position, and more particularly if they be bound and matted together by the pressure of tight bandages. A somewhat similar cause sometimes operates on the fœtus in utero: an abnormal position in the uterine cavity being very frequently the immediate occasion of some of the varieties of congenital club-foot. These deformities must not be confounded with congenital dislocations, in which there is always an arrest of development of some of the articular ends of the bones connected with the affected joint.

2. **Irritation set up in the Central Portions of the Nervous System** may produce deformity by deranging the proper antagonistic action of certain groups of muscles. This condition gives rise to many of the congenital as well as of the non-congenital deformities. It may act by producing more or less complete paralysis of one set of muscles, the contractility of their antagonists continuing normal; and thus, the relative balance of action being destroyed, the stronger will draw the part over to their side. The influence of this want of proper balance of parts in paralysis, producing deformity, may be well seen in the peculiar deformity of the hand and forearm described at p. 415, Vol. I., from paralysis of the musculo-spiral nerve in certain fractures of the humerus, and in palsy of the portio dura, where the face is distorted by being drawn to the sound side; or in squint, where, the sixth nerve being paralysed and the external rectus muscle having lost its motor power, the eye is drawn inwards by the action of its antagonist, the internal rectus. According to Tamplin, deformity from paralysis is never congenital, though it is not unfrequently met with in infancy. Central irritation may occasion deformity in another way, by producing tonic or permanent spasm of one set of muscles, the other remaining perfect in their contractility, but overbalanced by the continued contraction of their antagonists. This would appear to be the case in some forms of squint. Little has made the important observation, that many cases of deformity in infants appear to be due to mischief inflicted on the base of the brain during protracted and instrumental labours.

3. **Peripheral Nervous Irritation** may occasion contraction of the muscles and deformity. This we commonly see happen in cases of contraction occurring from the cutting of teeth, the irritation of worms in the intestinal canal, in the so-called hysterical contractions from uterine irritation, &c. From all these various causes, contraction and consequent deformity may arise. In some cases deformity will cease after the removal of the cause; but in other instances, in which it has been of long duration, the deformity will continue, owing to the muscles having fallen into a kind of rigid atrophy, being shortened and wasted, and consequently unfitted for the proper exercise of the actions of the part.

TREATMENT.—The *General Treatment* of deformity consists in removing the cause of the contraction in those cases in which it is dependent on central, peripheral, or nervous irritation that admits of remedy. Thus, if squinting arise from pressure upon the brain, the eye will assume its straight direction when the congested vessels are relieved, or the effused fluid absorbed; or if a contraction of the hamstring muscles arise from the irritation of worms in the intestinal canal, a purgative dose may cure the affection.

Electricity has of late years been much and most advantageously employed in the treatment of those deformities that arise from infantile paralysis, and, indeed, generally where the deformity is due to the paralysis of one set of muscles, allowing those that possess their healthy contractility to draw the parts to their sides. "Localised faradisation" is the method by which the electric agency is usually applied. But for the details of this method and the general question of the employment of electricity to these cases, I must refer the reader to the works of Duchenne (de Boulogne).

In many cases, the contraction may be slowly but very effectually overcome by the use of suitable apparatus, having a constant elastic or tensive action kept up by means of bands of vulcanised India-rubber or steel springs. The details of these various appliances, though belonging to the department of the instrument-maker, cannot be too carefully studied by the Surgeon, who, after all, in order to guide and control their action, must be thoroughly conversant with the mechanical principles involved in their construction. In many of the slighter and less chronic cases, the deformity may be remedied by the employment of these milder means; but in those which are congenital or more permanent, the *Division of the Tendons* at fault is the only mode of restoring the natural condition of the part. This *orthopædic* department of surgery owes, in a great measure, its existence to the labours of Delpech and Stromeyer, and its perfection to those of Little, Tamplin, and Adams.

**Tenotomy.**—By tenotomy, as at present practised, is meant the subcutaneous division of a tendon by means of a narrow-bladed knife (Fig. 518) introduced obliquely through a puncture by its side. In doing this, it should be borne in mind that the normal anatomical relations of parts are often a good deal disturbed in cases of deformity: and thus tendons may be approximated to arteries and nerves, from which, in the healthy condition of the limb, they are widely separated. The tendon may most conveniently be divided, in the majority of cases, by introducing the blade beneath it sideways, and then turning the edge against it, scratching through it by a kind of firm sawing movement, the handle of a knife being used as a lever to press the edge against the tendon, whilst the parts are made tense by an assistant. A drop or two only of blood are lost in this simple operation; and, as the divided tendon retracts with a kind of snap, a gap will be left between the two ends, from half an inch to an inch in width, according to the previous amount of tension in the part. If the muscles have been contracted for some years, it will commonly be found that the fasciæ in the neighbourhood of the tendon have become rigid and unyielding, forming cords or bands stretching across from the side of the gap. If these be very tense, they may be divided in the same way; but in many instances it will be found, after the lapse of a short time, that they will yield, and consequently will not require division. After the section has been made, the small puncture should be closed with a pad of lint and a strip of plaster,

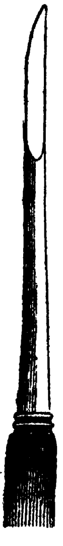


Fig. 518.—Tenotomy-knife.

the admission of air into the wound being carefully guarded against. The whole success of the operation depends on this. Should air enter, inflammation and suppuration will to a certainty be set up; whereas, if this be avoided, the wound will heal by the effusion of plastic matter without any inflammation. It is the entry of air, and not the subcutaneous wound, that gives rise to inflammation. The part should then be simply bandaged and either left without any apparatus, or supported by a splint in the same position that it occupied before the tendon was cut, no attempt at extension being made for three or four days. At the expiration of this time lymph will have been thrown out, and then proper mechanical contrivances may be adjusted for gradually restoring the normal position of the limb or part; if this be done too soon, the cicatrix will be extended at too early a period after the deposit of the plastic matter, and the tendon will become weakened and too much elongated.

Chloroform is not always admissible in these operations. When the muscle is not permanently shortened, but only contracted under its influence, it becomes so much relaxed that the defined edge of the tendon disappears, and the proper section cannot be made.

Sayre adopts a different method. He makes extension immediately after the division of tendons and fasciæ, and I have seen excellent results follow this practice. It is not, however, applicable in all cases, as, in some instances of talipes of old standing, the contraction appears to exist in the ligaments as well as in the more superficial structures. In such cases considerable resistance will be offered, and long continued extension be required.

The mode of **Repair in Divided Tendons** has given rise to some controversy, there being two theories with regard to the process. According to one, the plastic matter deposited between the divided and retracted ends gradually undergoes a process of contraction, analogous to what takes place in the cicatrix of a burn, so as to cause approximation of the cut ends of the tendon at the expense of the muscle, which becomes partially lengthened, until at last a transverse linear cicatrix merely is left at the line of section. Adams has, however, conclusively shown that this theory is erroneous, and that repair is effected by the deposit of plastic matter between the cut ends, chiefly from the sheaths and soft parts around; that this plastic matter undergoes gradual transformation into tendinous tissue; and that the tendon is actually lengthened and remains permanently so, by the deposit of this new material, which eventually resembles the normal structure of tendon so closely that the microscope fails to detect any appreciable difference, and that it can only be distinguished by its more translucent appearance from the old tendon. In fact, the divided tendon is completely reproduced.

In cases of congenital malformation, the question frequently arises as to whether tenotomy should be performed in early infancy, or delayed to a more advanced age. As a general rule I think that, if imperative, the sooner these operations are done the better; they are not more difficult at an early period of life than at any other, no danger attends them, and when they are performed during infancy, there is a far less chance of the deformity being permanent, than if the operation be delayed for some years. But it must be remembered that many slight deformities and contractions in infants may be removed without operation, by attention to proper mechanical and hygienic means. The Surgeon should, therefore, not be too ready to operate in slight cases at tender ages.

### DEFORMITIES AFFECTING THE FACE AND NECK.*

WRY-NECK.—Wry-neck, **Torticollis**, or **Caput Obstipum**, arises from spasm of one of the sterno-mastoid muscles ; the head being drawn to the affected side. On close examination in wry-neck, it will be found that there is a triple displacement of the head, which is drawn downwards, rotated outwards, and inclined laterally towards the affected side. The features lose their symmetry. The half of the face, and even of the head, on the affected side, becomes less perfectly developed ; and the true line of the eyebrows, eyes, and mouth becomes displaced and lowered.

In torticollis, the affected sterno-cleido-mastoid will be found hard, defined, and shortened ; sometimes both divisions of the muscle are equally tense, standing out in strong relief, so as almost to look like two distinct muscles. In other cases, one division, and then most usually the sternal, is chiefly affected. After a time the cervical vertebræ participate in and maintain the displacement, becoming rotated on their axes and curved. Eventually the whole spinal column participates in the displacement, and lateral curvature sets in. The deeper muscles also become shortened, and the anterior margin and clavicular attachment of the trapezius will often be found tense and preternaturally defined.

*Causes.*—Wry-neck occasionally appears to be congenital : more frequently it is acquired, coming on in childhood after measles or scarlatina, usually as a consequence of inflamed cervical glands, and is then due to the position instinctively assumed by the head in order to relax muscular tension on the inflamed side of the neck. It not unfrequently commences with an ordinary stiff neck from cold. In other cases, again, it is purely spasmodic, the tension of the muscle varying at different times, disappearing when the child is anæsthetised, and being overcome by gentle traction. In these cases the spinal accessory nerve is probably at fault, and it is owing to the irritation of it that the sterno-mastoid and trapezius muscles take on a spasmodic action. In spasm of both sterno-mastoids the head is thrown forwards, the muscles projecting in great relief. In these cases, the disease will usually be found to have had a rheumatic origin. Deformity in this situation may also occur from diseased cervical vertebræ, or from the traction of the cicatrix of a burn. The conditions here, however, are peculiar, depending upon causes that are irrespective of the state of the muscles, which are not tense, and may thus readily be distinguished from the true form of the disease produced by the causes above mentioned.

*Treatment.*—The treatment of torticollis arising from permanent spasm of one of the sterno-mastoids, which is the common form of the affection, may best be conducted by dividing the inferior attachment of the muscle, and thus allowing the head to regain its proper position. The division of the muscle is a somewhat delicate operation, on account of the important structures that lie immediately behind it. By making the incision, however, through it, from behind forwards, close to the sternum and along the clavicle, there can, if ordinary care be employed, be little risk of doing any damage, as these bones carry the lower attachment of the muscle forwards, and separate it from subjacent parts. The tension also, into which it is thrown by its spasm, draws it away from the carotid sheath. In several instances in which I have had occasion to perform this operation, no difficulty whatever has been experienced in dividing the sternal attachment of the muscle, which is usually very tense and prominent, by passing an ordinary tenotome behind the tendon, with its flat side towards it, just in front of the upper margin of the sternum, and then cutting forwards, whilst the muscle is put well upon the stretch. In dividing the clavicular insertion, the safest plan, I think, consists in making a puncture with a scalpel upon and down to the clavicle in the cellular space which lies between the two attachments of the muscle, and then pushing a long, blunt-pointed, narrow-bladed tenotome between that bone and the insertion of the muscle, dividing this in a direction forwards. Care must be taken to divide the muscle completely, but not to carry the incision too freely or deeply. I have heard of more than one case in which, from want of due precaution, abundant hæmorrhage occurred, and of three in which fatal results followed the operation.

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* For SQUINT, *vide* Chapter on "Ophthalmic Surgery."

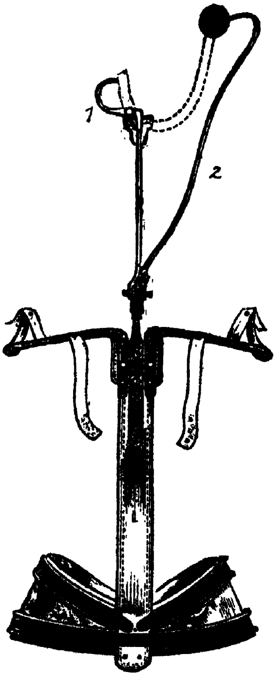

Fig. 519.—Bigg's Apparatus for Wry-neck.

After the operation, the position of the head must be gradually rectified by proper apparatus. The best instrument for this purpose is the one invented by Bigg, and here figured (Fig. 519). It consists of a pelvic band, a vertebral stem, and arm-pieces, the object of which is to secure a firm basis of support to the neck lever (1), and the maxillary lever (2). The neck lever passes round the head, and takes its bearing against the temporal bone on the side towards which the head is deflected. The maxillary lever acts against the lower jaw on the opposite side—that which is turned up. By means of a ratchet-joint the neck lever, the action of which is vertical, turns the head from the side to which it is deflected, whilst the maxillary lever, acting horizontally, rotates the head on its vertebral axis. By the combined action of these two forces the head is restored to its vertical position, and the chin replaced in the mesial line. In this way the curvature of the cervical vertebræ may gradually be corrected; should it, however, have existed for a considerable time, it may have assumed a permanent character, and a twist in the neck will continue for life. If the operation be not delayed until too late in life, the features will gradually regain their symmetry. After the division of the tendon, the deep fascia of the neck will sometimes be found stretching across in firm and tense bands; these, however, had better not be interfered with, as they will yield in time, and much risk of injuring the subclavian and carotid vessels would attend any attempt at their division. The exposure and division of the spinal accessory nerve has been practised, but not, I believe, with much benefit. When wry-neck is secondary to disease of the cervical vertebræ, little can be done except to maintain the spinal column in as steady and fixed a position as possible, by means of mechanical support (vide Fig. 254, Vol. I.).

In those cases in which the wry-neck appears rather to be dependent on paralysis of one sterno-mastoid, than on spasm of the other, electricity, and the application of strychnine to a blistered surface over the muscle, will be found most useful.

### DEFORMITIES OF THE ARM AND HAND.

**Contraction of the Arm** is not of very common occurrence, except as the result of burns. I have, however, met with four distinct forms of contraction of the forearm.

1. There may be ankylosis of the elbow-joint, the forearm being bent at a right angle with the arm, the result of disease of or around the articulation. If the ankylosis be fibrous, and the muscles strong and firm, a very useful limb may be restored by breaking down adhesions, under chloroform, by forcible flexion and extension, and then using passive motion, friction, and douches. Should the muscles be very flaccid and wasted, forcible extension may leave a permanently weakened limb, over which the patient has lost the power of flexion. In such cases I have found gradual extension, made by means of an angular splint, acted upon by a ratchet-apparatus, the safest means of restoring the utility of the arm. If the ankylosis be osseous, the bones should be resected, a wedge-shaped piece being sawn out, and a false joint allowed to form.

2. The biceps may, by its contraction, occasion a permanent flexion of the arm. This contraction of the biceps may be hysterical or rheumatic. When hysterical, occurring in young women, it requires the ordinary constitutional treatment of hysteria ; should this fail in removing it, extension may be made, under chloroform, and the arm kept in the straight position for a time. When it is rheumatic, or of organic character, and permanent, section of the tendon and its aponeurosis may be practised, due care being taken of the artery and nerve. This operation is most safely done by introducing the tenotome to the inner side of the tendon, slipping it under, and cutting upwards and outwards ; the artery being guarded and pushed to the inner side by the pressure of the left forefinger.

3. The forearm may be forcibly pronated and flexed as the result of chronic inflammation of the radio-humeral articulation. Here forcible supination and extension, under chloroform, is the best remedy.

4. The forearm may be bent on the arm in consequence of the contraction of the cicatrix of a burn along the inside of the limb. In this case, the plastic operation described at page 261, Vol. I., must be practised.

**Ankylosis of the Arm in the Straight Position** is a condition of very serious inconvenience, the limb being almost useless for all ordinary purposes of life. In cases of this kind, the treatment to be adopted must depend upon whether the ankylosis be fibrous or osseous. If it be fibrous, however firm, the forearm may always readily be brought into a rectangular position by flexion under chloroform, and the mobility of the joint may then be improved or restored by passive motion, friction, and douches. If it be osseous, the bony union must be sawn across, and the case treated as an ordinary instance of excision of the elbow, with a view of establishing a false joint.

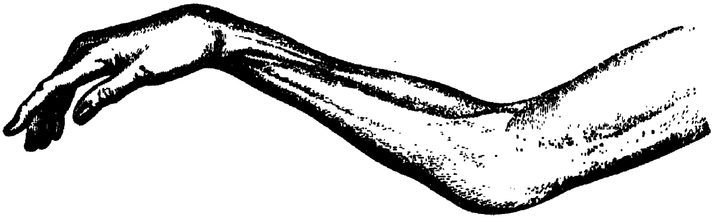

Fig. 520.—Contraction of Supinators of Forearm and Extensors of the Hand.

**Acquired Contraction of the Muscles of the Forearm implicating the Hand** is occasionally met with in adults. I have seen it in two opposite conditions; that of forcible extension (Fig. 520), and that of forcible flexion and pronation (Fig. 521). In both instances it appeared to have been the result of excessive use of certain muscles; in the first case in wringing out clothes, in the other in cutting with very heavy shears. In the case of flexion and pronation, it was interesting to observe that, when the fingers were extended, the wrist became flexed, and when the wrist was extended the fingers became bent in. In these cases change of occupation, friction, and galvanism, with the use of a straight splint, were advantageously resorted to, a cure being eventually effected.

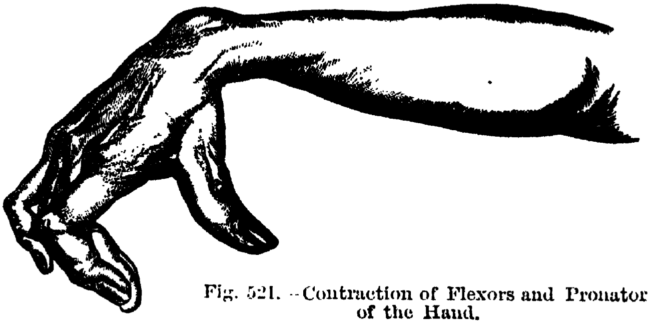

Fig. 521. —Contraction of Flexors and Pronators of the Hand.

**Paralysis of the Extensors and Supinators,** owing to injury of the musculo-spiral nerve consequent on fracture of the humerus, with or without tonic contraction of the flexors and pronators, has been described at page 415, Vol. I.

**Club-hand.**—A deformity resembling club-foot has occasionally, though very rarely, been met with in the hand. The contraction may occur in two directions; either in the sense of preternatural flexion, or in that of abnormal extension of the member. It has been described by Cruveilhier, Voillermier, and Smith of Dublin. In most of the cases that have been met with, there was a certain amount of deformity of the lower end of the radius, with congenital dislocation of the wrist; and in Smith's case there was an accessory semilunar bone in the carpus. Little, if anything, can be done by surgery for the relief of this deformity; though some benefit might possibly result from the division of any tendons that were preternaturally tense.

**Contraction of the Fingers.**—One or more fingers may be bent in consequence of contraction of the flexor tendons; the skin and fascial structures of the palm remaining sound. But this is not the form of contraction that is usually met with. In this, the true digital contraction, the tendons are unaffected, and the deformity is due to changes taking place in the integumental and fascial structures outside them. Most commonly this commences in the little finger, and thence gradually extends to the ring and middle fingers, which become so forcibly and firmly curved inwards, that their extension is not practicable. It usually results from frequent and continued pressure on the palm of the hand, as in leaning on a round-ended stick in walking, or in those trades in which an instrument requires to be pressed into the hollow of the hand. It occurs, however, in persons in the prime of life without any apparent exciting cause. In such cases I have always found it associated with a rheumatic or gouty diathesis; the disease in fact consisting in chronic thickening of the fasciæ of the palm and fingers, resulting from rheumatic inflammation of or deposits in these parts. On examining the contracted fingers, projecting ridges will be felt extending from the palm to their anterior aspects; and on endeavouring to straighten them, these ridges will be found to become stretched, and the palmar fascia to be rendered tense. The skin covering these fascial ridges is usually healthy, but sometimes adherent to them. So firmly are the fingers contracted, that by no effort can they be extended.

*Pathology.*—The pathology of this contraction has given rise to a good deal of difference of opinion amongst Surgeons. Dupuytren appears to have been the first who endeavoured, by dissection, to ascertain its true character. He found, on examining a hand which was the seat of this disease, that, after the removal of the skin, which was loose and flaccid, the contraction continued as before, and this, therefore, could not be its seat; but that the palmar fascia, which was exposed, was tense and diminished in size, whilst from the lower aspect some cord-like prolongations passed up by the side of the fingers; and that, when these were divided, the contraction was immediately removed, the tendons, the bones, and the joints being perfectly sound. He considered these fibrous cords to be digital prolongations of the palmar fascia, and consequently looked upon this membrane as the seat of the disease. Goyrand, who has carefully dissected hands affected in this way, states that these fibrous cords, which he looks upon as the seat of the affection, are not prolongations of the palmar fascia, but are ligamentous structures that extend from its anterior inferior aspect to the sheaths of the flexor tendons, into which they are inserted opposite the second phalanx; being an hypertrophied condition of the subcutaneous filaments of fibro-cellular tissue which naturally exist in this situation.

*The Diagnosis* of cases of digital contraction, so far as the deformity is concerned, is obvious, and requires no comment; so far as the cause is concerned, it is not so easy. Is it tendinous or fascial? When *tendinous*, the contracted tendon can be followed up to and above the wrist as a tense cord; the palmar structures being healthy. When *fascial*, the tendon cannot be clearly defined, but the palmar structures are dense, thickened, and incorporated together, forming distinct ridges and sulci.

This true digital contraction must not be confounded with that "arthritis deformans," which often distorts the weather-beaten hands of labouring men and sailors. In these cases all the fingers are bent inwards, and more or less twisted to the ulnar side, so that the hand presents a claw-like appearance, the mischief evidently affecting the joints.

*Treatment.*—The treatment of digital contractions is purely operative. The kind of operation must be determined by the pathological cause of the disease. If the contraction be tendinous, then subcutaneous tenotomy must be done. If, as far more commonly is the case, it be fascial, then the tendon and its sheath must not be touched, but the contracted structures outside them must be cut across. This consists, when the deformity is slight and recent, in dividing each tense digital fascial prolongation by a subcutaneous incision. This should be done opposite the second phalanx, where it is usually most tense; but, if the other finger-joints be affected, a separate section may be required opposite each phalanx. Should it be found to be impossible to straighten the fingers with such limited incisions, or should the skin be firmly adherent to the subjacent fibrous band, a long crucial incision may be made through the skin, the flaps dissected back, the fascial bands divided or dissected off the sheaths of the tendons, and the fingers straightened. As the flexor tendons are not primarily affected, they need not be divided. After the operation, the hand should be placed on a digitated splint, and the fingers kept extended.

Busch recommends the following modified operation, from which he says that he has derived excellent results in many cases. A Λ-shaped incision is made through the skin of the palm. The base corresponds to the furrow separating the bent finger from the palm of the hand. The apex reaches to the highest parts of the contraction when the finger is well stretched. The skin is dissected up from the apex towards the base, all condensed connective tissue removed, all fibrous cords passing upwards from the palmar fascia cut through, and the palmar fascia itself incised on each side of the sheath of the tendon, which is not touched. The finger gradually straightens itself during this operation. The flap is then laid down, and no extension apparatus or passive movement is employed until the wound is granulating.

**Congenital Deformities of the Fingers and Hand** are frequently met with.

1. The most common form consists in a **Supernumerary Finger or Fingers.** These are of several different kinds. There is, in the first place, that form of supernumerary finger in which the added digit appears to be simply a continuation of the natural series, so that there are six fingers instead of five. Seven have been met with; and Morand describes a hand having a thumb and six well-formed though somewhat shortened fingers. The supernumerary finger is usually atrophied and shorter than the rest. It is very common in these cases to find both hands equally provided with additional fingers, and the feet with one or more supernumerary toes.*

2. The **Thumb** is liable to two malformations—a supernumerary one being in some cases added; in others, the digit being bifid. In the supernumerary thumb (Fig. 522), it will usually be found that there are two small and deformed phalanges; in the bifid one, there is one small and malformed phalanx in each extremity, the two being articulated with the proximal phalanx.

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* These remarks will probably recall to the reader the description of one of the Philistine giants mentioned in the Second Book of Samuel. "And there was yet a battle in Gath, where there was a man of great stature, that had on every hand six fingers, and on every foot six toes, four and twenty in number."

3. The third variety of deformity consists in the development of a ***supernumerary finger*** on the ulnar side of the hand, so as to constitute a small and deformed additional little finger. All these varieties of deformity of the fingers are more or less hereditary, and may very easily be removed by operation, which is simple and perfectly safe, the supernumerary finger being disarticulated at its base. It is better to do this at as early an age as possible: no good can possibly come of delay.

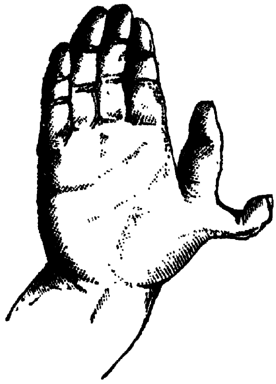


Fig. 522.—Supernumerary Thumb.

4. There is a rare variety of congenital deformity of the hand and fingers, in which the fingers are supernumerary, in consequence of a *deep bifurcation of the hand.*

5. In some rare cases, as in that from which the annexed drawing (Fig. 523) was taken, two hands appear to be fused into one. In these cases, no operation can be advantageously practised.

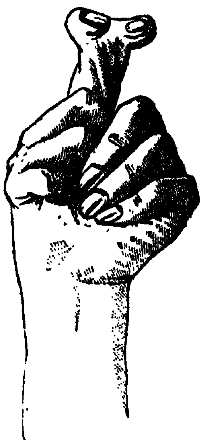


Fig. 523.—Apparent Fusion of Hands.

Besides these, various other kinds of congenital deformity of the fingers are met with. One or more fingers may be preternaturally long, or abnormally short, thick, or atrophied; or one finger may be entirely absent.

The accompanying drawings (Figs. 524 and 525) are correct representations of a remarkable deformity of the hand in a child that was under my care some years ago. The fingers appear to have suffered in some instances complete, in others partial, amputation in utero. They are marked by deep transverse sulci; others are shortened, and terminate in rounded nodules, with a narrow pedicle connecting them with the proximal phalanx.

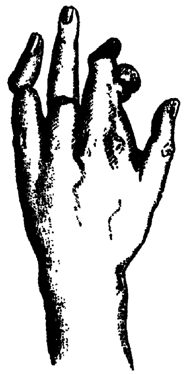
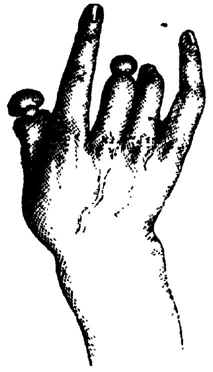


Arrest of Development of Fingers.

Fig. 524.—Left Hand.

Fig. 525.—Right Hand.

**Webbing of the Fingers** is occasionally met with. In this condition a cutaneous septum unites all the contiguous fingers. Sometimes the malformation is confined to one digital interspace, and then it is usually that between the index and middle fingers. In other cases it occupies two or all three interspaces. The web is a tolerably thick septum of skin, narrow at the base, broader above. It may extend the whole length of the fingers, or only a portion. The web does not interfere with the movements of the fingers in flexion or extension.

This deformity is readily remedied by operation. The web may be divided in different ways. The plan that I have always successfully adopted consists in separating the fingers widely, and then cutting through the web from its free edge, keeping accurately to the middle line as far as the base of the finger, making the incision longer on the dorsal than on the palmar aspect; or the web may be transfixed at the base, and the incision made forwards. Some Surgeons transfix the base with a ligature or wire, and, bringing it over the free edge, gradually tighten it, and so divide the abnormal bond of union. The objection to this process is that it is slow and painful. After the division of the web, the hand should be put on a splint, and a piece of lint interposed between the separated fingers during the whole process of union, so as to prevent any chance of re-adhesion. When the septum is very dense, the following operation, invented by Didot of Liège, may be advantageously practised. Supposing the index and middle finger to be webbed, the following would be the procedure to be adopted, which is of course equally applicable to any of the other fingers. 1. The Surgeon makes an incision along the median line of the palmar aspect of the index finger, extending the whole length of the web. 2. Two small transverse incisions are now made at the upper and lower ends of this longitudinal incision, extending from it to the ends of the web. 3. The rectangular flap thus defined is dissected back as thick as possible, so that its base corresponds to the mid-line of the web. 4. A corresponding longitudinal incision is now made along the dorsal surface of the middle finger, but comes rather further down on the hand. The two transverse incisions at its upper and lower ends are next made, and the flap thus defined is dissected back, and when the knife reaches the mid-line of the web the two fingers will be found to be separated. 5. The next and last step of the operation is to wrap each flap round the raw surface of the finger to which it continues to be attached, and to fix it *in situ* by three or four points of suture. Thus the raw surface on the index finger will be covered by the flap taken from the dorsum of the middle, and *vice versâ*, as is seen in the accompanying diagram (Fig. 526).

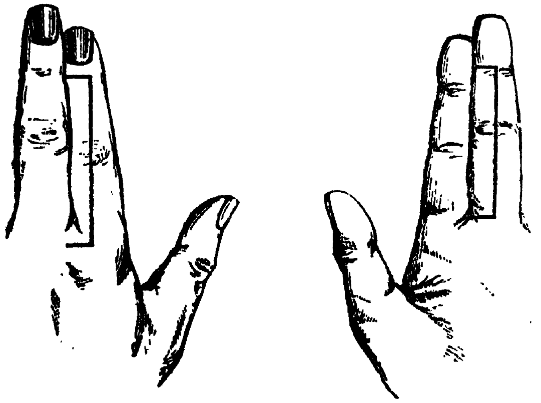


Fig. 526.—Diagram of Flaps in Operation for Webbed Finger, with thick Septum.

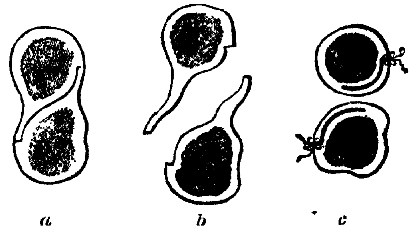


Fig. 527.—*a.* The lines of the two incisions uniting, so as to divide the Web and leave a Flap on each side. *b.* The Flaps detached from the opposite Fingers to those to which they are adherent. *c.* The Flaps applied to the Fingers, and covering in the raw and exposed surfaces.

In the accompanying cut (Fig. 527), the transverse section of the finger is shown.

## DEFORMITIES OF THE LEG AND FOOT.

**Knock-knee.**—The deformity termed **Genu Valgum, Knock** or **X-Knee,** usually affects both extremities, though it is generally more fully developed in one than in the other. In it the knee forms the apex of a triangle, the base of which would be represented by a line drawn from the trochanter to the outer ankle. It is usually conjoined with some curvature of the bones of the leg. It is not congenital, but commonly occurs in consequence of children being put upon their feet too early, the limbs thus giving way under the weight of the body. Bock states that, out of 221 cases which he examined, 17 originated about the period of the first dentition; and about 200 between that age and the 15th or 18th year. Some occupations are said to predispose to it, smiths being especially liable to the disease. In it there is relaxation of the internal lateral ligament; the biceps, the external lateral ligament, and often the vastus externus, are very tense; and the patella is thrown outwards. The external condyle of the femur will generally be found to be small, and the hollow of the ham to be obliterated.

*Treatment.*—The treatment consists, in the slighter cases, in applying an apparatus consisting of a well-padded iron stem along the outside of the leg and thigh; this must extend from the trochanter to the outer ankle, being fixed to a pelvic band at the upper part, and into a boot below (Fig. 528). Where it corresponds to the knee it should be provided with a hinge, and should have a broad well-padded strap passing from its under side, over the inner side of the joint, and attached by buckles to the upper part of the stem, in such a way that by tightening these the knee may be drawn outwards. This apparatus should be constantly worn for many months; and, if properly adapted, may effect a cure.

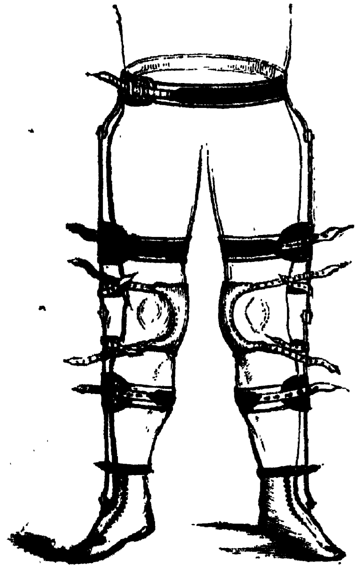


Fig. 528.—Apparatus for Knock-knee.

When the deformity is of old standing, and the parts about the outer side of the joint very tense, the biceps tendon may require division. In doing this, care must be taken not to injure the peroneal nerve. In some cases the vastus externus and contiguous portion of the fascia lata may also be advantageously divided, and the apparatus then applied as directed.

There is a form of bandy-leg which appears to be due not to curvature of the shaft of the tibia, but to a displacement inwards of the lower epiphysis of the bone, which at its line of junction with the shaft, appears to have yielded under the weight of the body, and so doubled inwards, carrying with it the foot.

**Contraction of the Knee-joint.**—Contraction of the knee-joint is one of the most distressing deformities to which the human frame is liable. If it be severe, the leg is bent at nearly, or perhaps at quite, a right angle with the thigh. It is fixed in this position, so that the patient cannot put the sole of the foot, nor even the points of the toes, to the ground; hence the limb becomes useless for the purpose of progression, and, from want of exercise, atrophies. But a leg with a badly contracted knee is worse than useless—it is a positive incumbrance; for, as the foot cannot be brought fairly to the ground, the limb projects behind in a most awkward manner, swaying as the body moves round, constantly in the way, and liable to injury. From want of exercise, the nutrition of the limb becomes impaired: the foot is usually habitually cold, the circulation in it is languid, and the toes become liable to chilblains and troublesome ulceration.

In the less severe forms of contracted knee, the inconvenience, though not so great as that just described, is very considerable; for, as the patient can never bring the heel or sole to the ground, he rests insecurely on the tips of his toes, and walks but unsteadily with the aid of a crutch or stick.

*Varieties.*—This deformity may be of two kinds. 1. It may consist of simple flexion of the leg on the thigh, at a greater or less angle, and with more or less mobility, according to the degree of ankylosis. 2. In addition to this, there may be horizontal displacement of the bones, the head of the tibia being thrown backwards, the femur and patella remaining *in situ*, but apparently projecting more than is natural.

In examining a case of contraction of the knee-joint, the patient should be placed on his face, with the thigh extended. The leg on the affected side will then be raised more or less perpendicularly, and the amount of contraction may be judged of by the angle that it forms with the thigh. The degree of mobility also may readily be ascertained. In this way a more correct idea of the amount of contraction can be obtained than by examining the patient whilst lying on the back, when, in consequence of the thigh being flexed on the abdomen, the extent of the angular deformity cannot be so well determined.

*Causes.*—Contraction of the knee-joint may arise from a great variety of pathological conditions. Some of these are altogether external to the joint, being seated in the nerves or muscles of the limb; whilst others, and the majority, consist in some morbid change that has taken place within the joint itself in its ligamentous or osseous structures. As the contraction depends on such very varied causes, the *Treatment*, having reference to the cause as well as to the actual morbid conditions, must be equally diversified.

**Contraction from Nervous Irritation** is usually associated with general hysteria, of which it is but a local symptom, and commonly occurs in girls and young women. In this form of contraction there is no evidence of disease within the joint; no redness, swelling, or other sign of inflammation; but there is great pain and tenderness about it. This pain, as usual in hysterical cases, is superficial and cutaneous, and radiates to some distance beyond the articulation. Any attempt at straightening the limb not only greatly increases the pain, but also calls the adjoining muscles into such forcible action that it is impossible to improve the position. These local symptoms are connected with the ordinary signs of an hysterical temperament, with spinal irritation, and often with uterine derangement.

The *Treatment* of these cases of *hysterical contraction* of the knee is simple. The first thing to be done is to straighten the limb. This can only be effected by putting the patient under the influence of chloroform, when, all sensibility being suspended, the muscular opposition, which is partly voluntary, and no doubt in some measure reflex, is no longer called into action, and the limb falls of its own accord almost into the straight position, in which it must be retained by means of a long splint, lest the retraction recur with returning consciousness ; and then, the hysterical condition being removed by treatment calculated to improve the general health, the tendency to the return of the deformity will be obviated.

We occasionally see contraction of the knee from spasmodic action of the hamstrings, produced by some irritation applied to the nerves at a distance from the part. Just as spasm of the internal rectus muscle of the eye occasions squint, so long as the irritation that gives rise to the spasm lasts ; so there may be spasm of the hamstrings, with contraction of the knee as a consequence.

Most commonly, however, the joint itself is at fault, either in consequence of subacute inflammatory action within it, or of the chronic and permanent changes induced by former inflammatory attacks.

**Contraction from Inflammation of the Knee.**—In inflammation of the knee, the patient naturally and instinctively places the limb in the semiflexed position, as being that in which there is least tension exercised on the structures that enter into the joint, and consequently that which is most congenial to his feelings. This position, which is immediately assumed on the occurrence of acute and active inflammation in the joint, comes on more gradually in cases of subacute inflammation ; and here the symptoms of disease in the joint may be so slight that the contraction may be considered the chief ailment, and engross too exclusively the Surgeon's attention.

**Chronic Contraction.**—The next class of cases that we have to consider are those of a more chronic and intractable kind, lasting often for years, dependent upon structural lesions of a deep and important character in and around the joint, and requiring very active surgical interference for their cure. These chronic forms of contracted knee appear to arrange themselves in three distinct varieties, being dependent—1, on Consolidation and Contraction of the Ligamentous Structures in or around the joint ; 2, on Permanent Contraction of the Muscles, with or without the last-named condition ; and, 3, on Osseous Ankylosis. Each of these varieties will require separate consideration, as each demands a special mode of treatment for its cure.

1. Those cases of contraction of the knee that depend on *Consolidation of the Ligamentous Structures* in and around the joint, resulting from former inflammatory attacks, are not only the most numerous, but the most readily amenable to treatment. When the structures outside the joint, such as the capsule and ligaments, are the parts chiefly affected, the inflammation has usually been of a rheumatic character. When the internal structures have been disorganised, and fibroid deposits have taken place within the joint, the inflammation has generally been strumous. In these cases the knee is usually fixed at or near a right angle, and is capable of but very limited motion ; to such a degree only, in most instances, as will allow the foot to move to the extent of two or three inches. The hamstring muscles are not tense, even when the knee is extended to its utmost ; and, indeed, in some cases they are

flaccid, and feel soft. Not unfrequently the leg can be extended up to a certain point, with as much freedom as in the natural state, and then further movement is checked by a sudden stop. If this be not dependent on the tibia coming into contact with an ankylosed patella, it is owing to shortening of the posterior or of one of the crucial ligaments, or to the formation of adhesions within the joint. In this form of contraction, the knee is often much distorted, in consequence of the head of the tibia being partially dislocated backwards, the femur having its axis directed more or less on one side, most commonly inwards, constituting a kind of genu valgum. In fact, in these cases the distortion of the limb is of a threefold character; there are, 1, contraction in the angular direction backwards; 2, displacement of the head of the tibia backwards from the lower end of the femur, which projects considerably forwards; and 3, rotation of the leg and foot outwards. The angular contraction is dependent upon adhesions in the joint, and on the gradual tendency to flexion that all inflamed joints assume. The partial dislocation backwards is dependent on softening and consequent relaxation, either of the ligamentum patellæ or of one or other of the lateral ligaments. When the head of the tibia is displaced backwards, it will most generally be found that the ligamentum patellæ has been either partially absorbed, and thus weakened; or that it is elongated, the patella being drawn upwards or to one side. In either way, the action of the extensor muscles of the thigh upon the head of the tibia is weakened; and that bone, being consequently brought under the influence of the hamstrings without a counterpoise, is drawn backwards (Fig. 529). In those cases in which there is lateral rotation of the tibia, the faulty position may either have arisen from the attitude that limb has been allowed to assume during the progress of the disease in the joint, or the leg was rotated outwards by the action of the biceps overcoming that of the inner hamstrings.

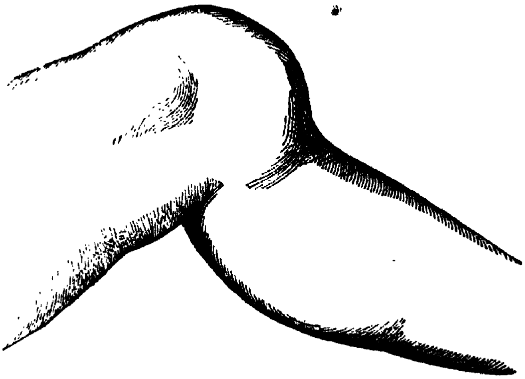


Fig. 529.—Chronic Contraction of Knee-joint; Head of Tibia drawn backwards.

When the knee has been chronically contracted for some length of time, the ligamentum posticum becomes permanently shortened, in consequence of having been kept so long in a state of relaxation, and its folds becoming obliterated. Hence this condition of the ligament offers the chief obstacle to extension.

**Treatment of Contraction of the Knee.**—Extension of the limb will prove sufficient when there is simple angular contraction. This may either be done gradually by means of the screw-splint behind the knee, or forcibly and at once, under the influence of chloroform. I prefer the latter method, not only as being the speediest, but as being perfectly safe and effectual. The mode of effecting forcible extension is as follows. The patient being fully under the influence of chloroform, and lying on his face, the Surgeon, standing above him, seizes the foot of the affected limb with one hand, whilst with the other he steadies the limb just above the knee. He now extends the leg gradually but forcibly; as it comes forwards, the bands of adhesion in and around the joint will be felt and heard to give way with loud snaps and cracks, distinctly audible at some distance. Should there be much resistance within the joint, the Surgeon may apply his own knee or elbow to the upper surface, and thus increase the force with which the limb is acted upon. In this way I have never found any contractions of the kind now under consideration able to resist the Surgeon's efforts, nor any difficulty in effecting at once the extension of the limb. Nor have I ever seen any evil consequences result; indeed, it is surprising to what an amount of force a joint that has been contracted for any length of time may be subjected without inconvenience. In these cases it would appear as if the synovial membrane lost its susceptibility to inflame, just as is the case with serous membranes that have been the seat of chronic inflammation and its consequences. Beyond some pain for a few days, and slight heat, easily subdued by cold evaporating lotions, I have never seen any ill results arise; but then care must be taken that no inflammatory action is going on within the joint at the time of this manipulation, as, if such action were present, the operation would certainly be followed by injurious results. After the extension has been made, the limb should be fixed on a long splint, well padded, some evaporating lotions applied, and the patient kept in bed for a few days, after which, with the aid of a starched bandage, he may walk about.

When the triple displacement which has already been referred to exists—viz., angular contraction, displacement of the head of the tibia backwards, and rotation of the limb outwards—simple extension is no longer sufficient for the remedying of the deformity. In these cases the hamstring tendons may often require division, generally on both sides—sometimes only the external one; and extension may then require to be effected, either forcibly, or by the gradual and slow action of rack-and-pinion apparatus. After extension has been effected, the position of the head of the tibia backwards may still occasion considerable deformity and weakness of the limb (Fig. 530). This condition is best removed by the use of the instrument of which the sketch on next page (Fig. 531) is a good representation; it was designed and constructed by that excellent surgical mechanician, Mr. Bigg. The diagram (Fig. 530) represents a limb with the tibia displaced backwards, the angular contraction having been remedied. In the centres of the end of the thigh-bone and of the head of the tibia, two letters (X and Z) are placed to designate the axis of each bony head, beneath and above which the displaced joint has formed its abnormal axis. The dotted lines represent the leverage formed by the cylindrical surface of the tibia and thigh-bone. The arrows are placed in such a direction as the bones would take in resuming their normal position. It will readily be seen that any instrument capable of acting in the mechanical directions shown by the arrows, would not only accomplish the restoration of the joint, but extend, if contracted, the extremities of both femur and tibia.

An additional advantage that this instrument possesses over any other with which I am acquainted, is the application of spring-power, by means of which flexion of the knee becomes an element towards the restoration of its utility.

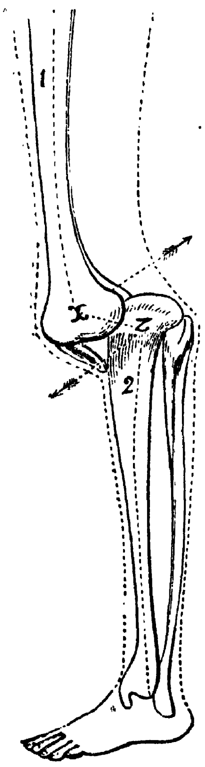


Fig. 530. — Knee-joint after Extension: Head of Tibia thrown Backwards.

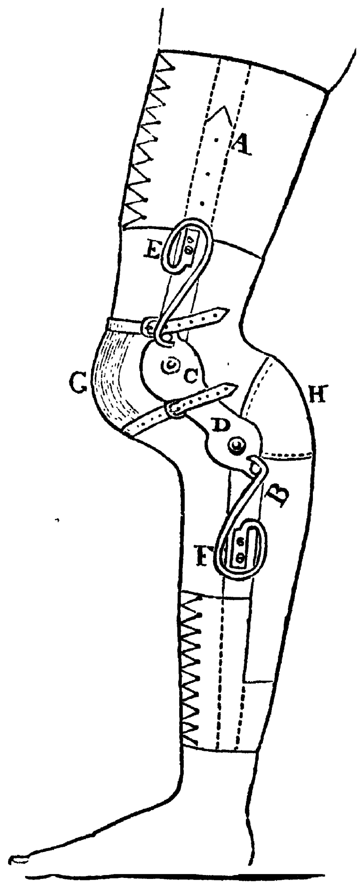


Fig. 531.—Apparatus for restoring Position after Extension of Contracted Knee-joint.

Instead of muscular action being arrested, and atrophy of the limb being thus produced, movement is conducive to the perfect action of the apparatus; so that the patient experiences but little inconvenience from its use, all the ordinary positions assumed by the knee in walking, sitting, or standing being preserved.

By this form of apparatus, then, three important points are secured: viz., replacement of the head of the tibia, extension of the angle of the leg, and free muscular action during the period of treatment.

In Fig. 531, A and B are two levers, composed of metal, corresponding in their direction to the perpendicular position of the thigh-bone and tibia. C and D are two axes, placed exactly coincident with the centres of the articular ends of the bones. E and F are two powerful springs, acting in opposing directions; viz., in those indicated by the arrows in Fig. 530. Thus F presses the lever B in an anterior direction, bearing the end of the tibia forward, whilst E presses the lever A in a posterior direction, bearing the end of the thigh-bone backward. As C and D are found acting above and below the actual axis of the knee-joint, they mutually influence the point formed by the apposition of the heads of the tibia and thigh-bone; and as it has already been explained that the thigh-bone really offers a fixed resistance, and the tibia moves beneath it, the head of the latter bone is turned anteriorly in a semicircular direction consequent on the upper centre (C) being a fixed point, and the lower centre (D) rotating around it. G is an elastic knee-cap; H, a padded plate. When the ligaments are tense, there is a chance of pressing the anterior surface of the tibia against the posterior surface of the thigh-bone. This is readily obviated by having the shaft (A) made to elongate, when the centre (C), being a little lowered, pushes the lever (B) downwards, carrying the tibia with it, and thus separating the osseous surfaces of the joint.

2. The next class of cases of contracted knee that we have to consider is

that in which the *Hamstrings are Contracted*, either alone or in addition to those results of chronic inflammatory action within the joint that have just been described. In these cases the hamstrings will be found to be tight; and, in proportion as the leg is extended on the thigh, they will become more tense, until at last all further extension is resisted, apparently by their traction, and not by any sudden check or stop within the joint itself.

**Division of the Hamstring Tendons** is in ordinary cases as simple an operation as any in surgery, unattended by any difficulty, provided the Surgeon introduce the tenotome parallel and close to the side of the tendon to be divided, and cut in a direction from the inside or popliteal aspect towards the skin. The outer hamstring will usually be found to be the most tense, and should first be divided. In doing this, the peroneal nerve might appear to be in danger; but this may be avoided by keeping the side of the tenotome well against the inner edge of the biceps tendon, then turning the edge outwards, when passed deeply enough. The semitendinosus next requires division. The semimembranosus need not often be cut across. After the division of the tendons, tense aponeurotic bands will not unfrequently be found to stretch along one or both sides, or perhaps down the centre of the popliteal space. This may lead to the idea on the part of the Surgeon that he has not fairly cut the tendons across; but this is an error. The bands alluded to are condensed sharp-edged prolongations of the fascia lata, formed during the period of contraction of the joint by the retraction and thickening of this membranous expansion. Such condensations as these had better be left untouched, as they will readily stretch out under gradual extension, or be ruptured by forcible traction of the limb. If, on the other hand, the Surgeon be tempted by their apparently superficial and safe position to proceed to their division, he may be led into a serious dilemma by being brought more closely into contact with the popliteal vessels than is desirable or safe. In these cases, the anatomical relations of parts are so much altered by the narrowing of the popliteal space, and by the projection of the head of the tibia backwards, or by its lateral rotation, that the Surgeon is unable to calculate with sufficient nicety the precise position of the large vessels and nerves in the neighbourhood of which he is about to act; and he may thus injure one or other of these at a time when he thinks that he is operating at a safe distance from them.

After the division of the hamstrings, the knee does not commonly come readily into the straight position, owing to the shortening of the posterior ligament; and gradual extension, by means of proper apparatus, will be required to overcome this and to stretch the adhesions within and around the joint.

**Contraction with Lateral Displacement** is not unfrequently met with. In these cases the knee is contracted more or less in the angular direction; but, in addition to this, the lower end of the thigh-bone is directed inwards, and perhaps somewhat forwards, and the tibia is rotated outwards, carrying the foot with it. There is thus a triple deformity—angular, mesial, and rotatory. I believe the angular to be the primary deformity and the mesial and rotatory to be secondary to this, arising partly from the efforts of the patient to walk by resting on the point of the great toe, and throwing the thigh inwards in order to effect this, and partly from the action of the biceps rotating the leg outwards.

The *Treatment* of these cases is not very satisfactory. The obstacle to the restoration of the normal position of the joint is dependent, so far as the angular contraction is concerned, on shortening of the ligamentum posticum, and the rotatory displacement is kept up and rendered intractable by shortening of the anterior crucial ligament. Mere extension of the limb, whether gradual or forced, may counteract the angular deformity; but it will not only leave the other displacements uninfluenced, but may actually increase the displacement of the tibia backwards and the rotation of the leg outwards. A leg-and-thigh splint, such as in Fig. 531, but having, instead of the springs, a rack-and-pinion apparatus working on three centres, so as to extend the limb, abduct the knee, and rotate the leg inwards, is the only contrivance by which this deformity can be counteracted, and the limb properly restored to shape.

In reference to the treatment of these various deformities of the extremities, it may be stated generally that it is much easier to rectify faulty position than to restore mobility. The first may always be done by the various means that have been enumerated; the latter can only be effected, if at all, by long-continued efforts on the part of the Surgeon, by passive motion, frictions, shampooing, &c., aided by properly constructed apparatus.

In ankylosis of the knee, after extension has been made, and the limb brought straight, the question arises as to whether mobility of the joint should be encouraged, or the limb kept straight and made stiff. The answer to this question will greatly depend on conditions of the muscles of the thigh. If the quadriceps extensor exhibit electric irritability, then, if the state of the joint admit it, motion may be attempted. If the muscle be insensible to the stimulus, then the joint had best be kept stiff.

3. **Osseous Ankylosis of the Knee** is not of very frequent occurrence. It is usually, if not invariably, the result of traumatic inflammation of the joint. If the limb be straight, no operation will be advisable; if it be *bent*, so that the patient cannot put the foot to the ground, the only remedy will be an operation. Rhea Barton, of Philadelphia, in 1835, proposed an operation for restoring the straight position of the limb in cases of complete osseous ankylosis of the knee-joint with angular deformity. The proceeding consists in excising a wedge-shaped piece of the shaft of the femur above the condyles, not including the whole diameter of the bone, then fracturing the undivided portion, and so bringing the limb into a straight position. Birch, of New York, in 1844, modified this operation by sawing out a wedge-shaped portion, consisting of the condyles of the femur, the patella, and the head of the tibia. According to Gross, these two operations have been done in all in 21 cases, of which 4 proved fatal by pyæmia. In one case, that of Reil, the femoral artery had to be tied for secondary hæmorrhage from the popliteal on the fifteenth day: but the patient made an excellent recovery with an useful limb. Brainard of Chicago, in 1854, proposed a simple and less severe method than either of the above, for the remedying of angular osseous ankylosis of the knee. It consisted in drilling the femur subcutaneously and then fracturing the bone. This operation was first done by Pancoast in 1859, and since then has been successfully practised by Brainard, Gross, and others, who have extended it to subcutaneous perforation of the joint and to separation of the patella.

The drill that is used for this operation consists of a steel shaft 4½ inches long, fitted with a solid and rounded handle (Fig. 532). The point is $\frac{1}{6}$th of an inch in breadth, and has on each side an oblique groove with cutting edges, so that it acts as a gouge as well as a drill. The interior of the obliterated articulation is reached by making an incision about half an inch long on the outer side of the limb, at the line of juncture between the condyles of the femur and the tibia. The drill is then worked through, until its end can be felt under the integuments on the opposite side of the limb. The instrument must now be worked in such a manner as to break down the osseous adhesions between the femur and the tibia on the one hand, and the patella on the other. The patella is sometimes best loosened by using the drill as a lever. When the bones have been sufficiently perforated in different directions, the limb must be extended, when the remaining osseous connections will give way with a cracking noise. The wound in the integument is then closed with silver sutures and collodion, and the limb laid on a pillow. In three or four days it may be put in a McIntyre splint, and gradual extension practised, the soft parts posteriorly slowly yielding. Bony union will then take place ; but it is a decided advantage when the limb is stiff for the knee not to be quite straight, but slightly flexed, so that the leg may be about an inch shorter than the opposite limb.

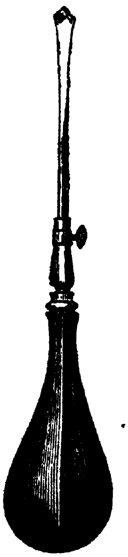


Fig. 532.—Drill for Ankylosed Knee.

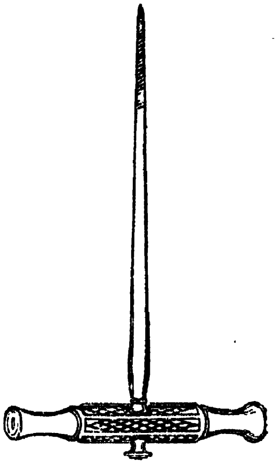


Fig. 533.—Drill for Ankylosed Joint.

This operation, it will be seen, is in many respects superior to those of Barton and Buck ; for whilst bringing the limb into an equally good position, it does so by a comparatively slight and subcutaneous procedure, unattended by any danger of hæmorrhage or of complications arising from an extensive external wound. The nine cases in which it has been done were all successful. These various perforating operations appear hitherto to have been confined to the knee-joint. But there can be little doubt that they might advantageously be extended to other joints, when affected by osseous ankylosis, more particularly in the elbow and the hip. In angular contraction of the knee-joint with dislocation of the tibia backwards, Volkmann has improved the condition of the limb and materially corrected the deformity, by cutting across the femur just above the condyles, and in one case by doing the same to the tibia just below its head. This he recommends to be done with a chisel, the wound being dressed antiseptically.

Ankylosis of the knee in the *straight position* interferes comparatively little with the utility of the limb. It is, however, desirable, when practicable, to restore the flexibility of the joint. The possibility of doing this will depend on the degree of ankylosis. If this be osseous, or even if densely fibrous, little can be done ; but if the rigidity depend chiefly on condensation of the capsule, and the deposit of plastic matter externally to the joint, much may be effected by the use of properly constructed apparatus. This should be of two kinds: 1. A leg-and-thigh piece securely laced on to the limb, having an angular joint opposite the knee, and united posteriorly by a strong band of vulcanised India-rubber, the elastic tension of which is constantly striving to overcome the straightened limb by flexing it backwards; and 2, a similar apparatus, with rack-and-pinion, instead of elastic, by which the knee can be screwed back once at least in the day.

Ankylosis of the knee in the *angular position forwards*, so that the leg is bent upwards upon the thigh, is very rare. Indeed, I am acquainted with only three preparations illustrating this deformity—one in the museum of University College, one in that of St. Thomas's Hospital, and another exhibited by Adams to the Pathological Society, from a limb amputated by Grant, of Canada, in which this condition occurred in a young man as a consequence of a wound of the joint some years previously.

CLUB-FOOT.—Deformities of the foot may either affect one or both of the extremities. They may be congenital or acquired, and may occur in either sex, but appear to be more common amongst boys than girls. There are four primary varieties of club-foot, and two secondary ones. Of the four *primary* forms, in two the deformity is in the antero-posterior direction, in the sense of flexion and of extension: **Talipes Equinus**, in which the heel is drawn up and the toes pointed downwards; and its antithesis, **Talipes Calcaneus**, in which the heel is pointed downwards and the foot and toes drawn up. In the remaining two forms the deformity is lateral, the foot being adducted and twisted inwards in **Talipes Varus**, and abducted and twisted outwards in **Talipes Valgus**. The four primary forms of club-foot correspond with and are dependent on a permanent condition of one or other of the four simple movements of which the foot is susceptible at the ankle-joint.

Thus in Talipes Equinus the foot is extended, the heel being raised, and the dorsum pointing downwards in a line more or less direct with that of the anterior part of the leg. This is due to permanent contraction of those muscles that are inserted into the tendo Achillis. In Talipes Calcaneus the foot is drawn up and the heel is depressed, so that the dorsum forms an angle more or less acute with the front of the leg. Here the tibialis anticus is the muscle chiefly at fault. In Talipes Varus the foot is adducted forcibly, and the inner side of the sole raised sometimes to a right angle with the ground; this is due principally to the action of the tibialis posticus and tibialis anticus, and in Talipes Valgus we have the converse, abduction of the foot, and raising of the outer side of the sole, due to the action of the peronei muscles.

Besides these four primary forms, there are two secondary varieties of club-foot; **Talipes Equino-varus**, in which the heel is raised and the foot drawn inwards; and **Talipes Calcaneo-valgus**, in which the heel is drawn down and the foot turned out. The *Talipes Equinus* and *Varus* are commonly associated, because in these forms the flexor and adductor muscles, viz., the strong muscles of the calf and the tibialis posticus, those that are supplied by the posterior tibial nerve, are contracted. The *Talipes Calcaneus* and *Valgus* are associated, because in these the extensor and the peroneal muscles, those supplied by the peroneal nerve, are the seat of contraction. In some forms of club-foot, especially in the varus and equino-varus, it will be found that the muscles antagonistic to those that are contracted are in a state of atrophy and defective innervation—in this case the extensors on the anterior part of the leg and the peroneals. In such instances as these, electricity becomes an important adjunct to the more directly surgical and mechanical treatment.

In infants with talipes, Sayre begins treatment at once, as soon as possible after birth, by drawing the foot into position. When this is done, it becomes quite white and bloodless. The traction must then be discontinued, but may be resumed again in a very short time, and so repeated. After a time the limb may be fixed in proper position by the application and traction of plaisters; and thus if the talipes be not cured, it may very early in life be much ameliorated and rendered more fit for treatment.

*Pathological Changes.*—On dissecting a foot affected by talipes, it will be seen that but little alteration has taken place in the condition of the bones. In some preparations of this kind which are in the University College Museum, these are nearly in a normal condition (Figs. 535, 538). Indeed, in talipes equinus and calcaneus, they are scarcely if at all altered; but in talipes varus, if of old standing, the astragalus will generally be found atrophied, more particularly about its head, which may be somewhat twisted, and the scaphoid and cuboid bones will be seen to have undergone similar changes. The ligaments are necessarily somewhat altered in shape, being lengthened on the convexity, and shortened on the concavity of the foot; the direction of the tendons is altered, and the muscles, not only of the foot, but of the leg and thigh, are generally atrophied from disuse, so that the limb in old cases is withered and shortened; indeed, so great an incumbrance may it occasionally become under these circumstances, that amputation of the leg may be insisted on by the patient, and with propriety be performed by the Surgeon.

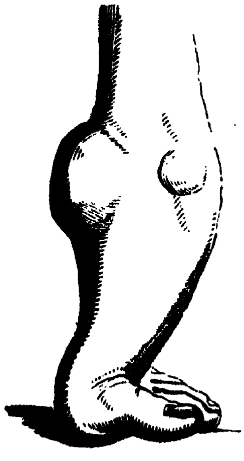


Fig. 534.—Talipes Equinus.

**Talipes Equinus** is characterised by elevation of the heel, and tension of the tendo Achillis. In slight cases the heel may merely be raised a few lines above the ground, and it will be found on examination that it cannot be bent forwards to an acute or even to a right angle with the leg. In severe cases the foot may be extended in nearly a straight line with the leg, and the patient walks on his toes, which are placed at a right angle to the foot (Figs. 534, 535). In this deformity there is no lateral displacement. According to Tamplin, it is never congenital. It most commonly arises from disturbance of the nervous system during teething. In adults, as well as in children, it may come on from some disease, such as an abscess in the calf of the leg, by which the

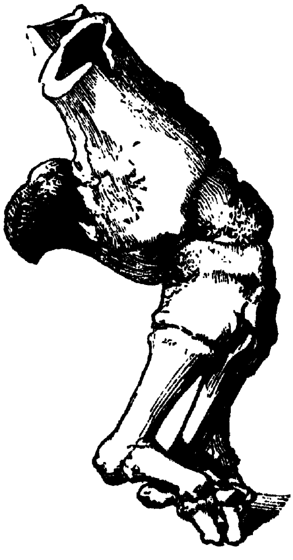


Fig. 535.—Bones in Talipes Equinus.

gastrocnemius muscle is crippled, shortened, and contracted. It is the most important, and at the same time the simplest in itself, of all the forms of club-foot; it commonly complicates the varus.

The *Treatment* consists in *dividing the tendo Achillis*, and bringing the heel well down.

The tendo Achillis is best divided about an inch above its insertion into the os calcis. The patient should be laid prone; the Surgeon, grasping the foot, extends it forcibly, so as to throw out the tendon in good relief, and make it tense; he then slides a tenotome beneath it, and cuts slowly through it from beneath upwards, bearing well upon the foot; as the division proceeds, he will hear the tendon cracking as its fibres are successively cut through. The division should not be made from above downwards, as the posterior tibial artery or its malleolar branches might readily be wounded.

**Talipes Calcaneus** is an extremely rare variety of club-foot. In it the heel is depressed, the toes and anterior part of the foot being elevated (Fig. 536); it is usually, I believe, congenital—in one case, however, that of a girl twelve years of age, it was acquired. It arises from contraction of the extensor tendons.

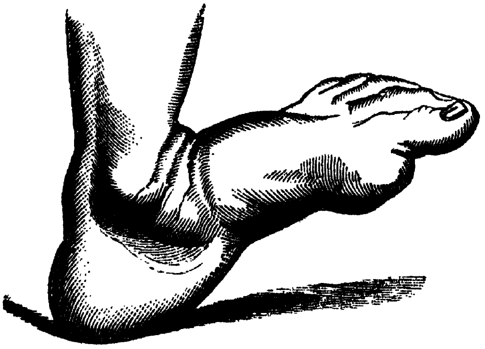


Fig. 536. Talipes Calcaneus.

*Treatment.*—In order to bring down the foot, the tibialis anticus, the extensor communis, the extensor pollicis, and the peroneus tertius tendons, may all require to be divided as they pass over the dorsum; a straight splint should then be applied, and the foot drawn down to it. A minor degree of this affection consists in a peculiar projection upwards of one or two of the toes, associated with some tension of the extensor tendon; by dividing this, and keeping the foot on a flat splint, the deformity may commonly be corrected. In some cases, however, the toe is so prominent, and the contiguous ones are squeezed under it in such a manner, that the foot is completely crippled, and amputation of the displaced digit is required in order to restore the utility of the member.

**Talipes Varus.**—In this deformity the foot is twisted inwards, and the inner side of the sole is raised, and the sole is contracted; the patient walking on the outer side of the foot, where the skin covering the tarsal end of the fifth metatarsal bone often becomes excessively dense and firm, and a bursa occasionally forms (Figs. 537, 538). In most cases there is some elevation of the heel, the affection partaking somewhat of the character of talipes equinus. It is the most common form of congenital deformity, both feet being found similarly affected; but it may be non-congenital, dependent on infantile paralysis of the extensors, and then is often limited to one foot.

The *Treatment* consists in the successive division of the tendons of the tibialis anticus and tibialis posticus, which are the muscles principally at fault. After these have been cut across, the tendo Achillis should be divided; but its section should be made last, as it steadies the foot, and thus facilitates the division of the tibial tendons. In most cases the plantar fascia is contracted, and requires division wherever it feels tense and projecting. In the section of the tibialis posticus tendon behind the ankle, there is much danger of wounding the posterior tibial artery, which lies close to it. The best way to avoid this vessel is, as Tamplin recommends, to puncture the sheath of the tendon

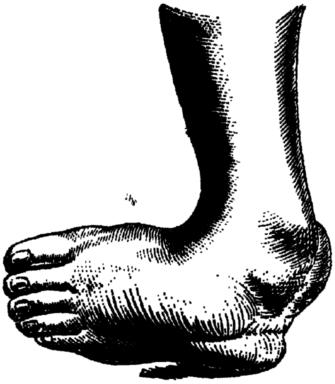


Fig. 537.—Talipes Varus.

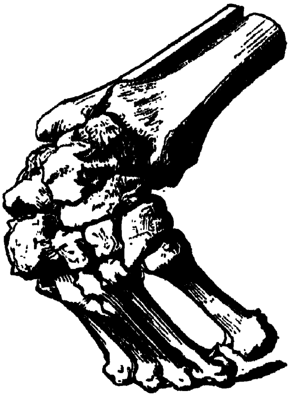


Fig. 538.—Bones in Talipes Varus.

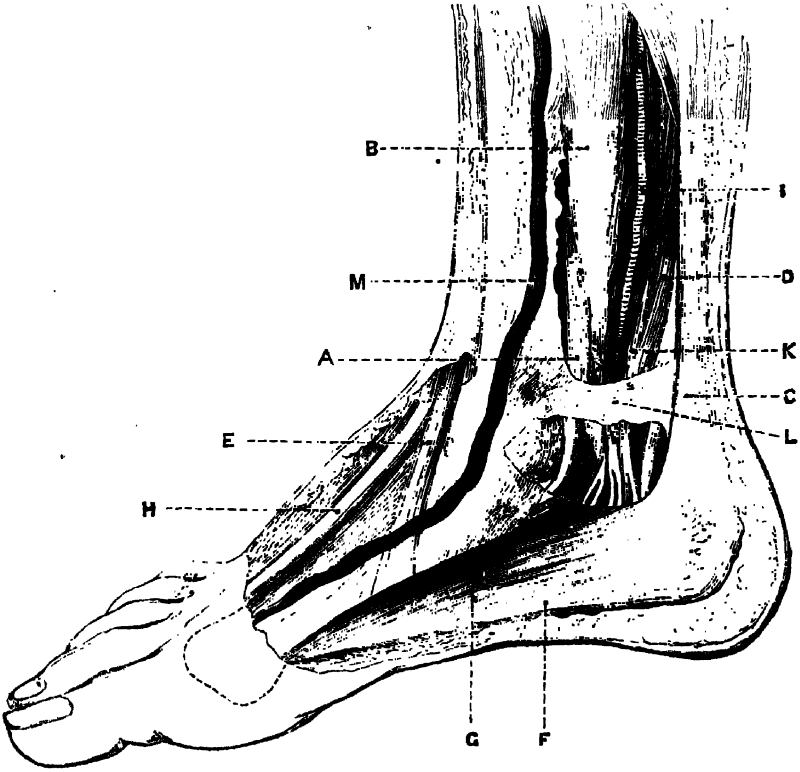


Fig. 539.—Relation of Tendons divided in Equino-Varus.

A Tibialis Posticus. Point at which cut.
B Flexor Longus Digitorum.
C Tendo Achillis. Point at which cut.
D Flexor Longus Pollicis.
E Tibialis Anticus. Point at which cut.
F Plantar Fascia.
G Abductor Pollicis.
H Extensor Longus Pollicis.
I Posterior Tibial Artery.
K Posterior Tibial Nerve.
L Part of Annular Ligament.
M Saphena Vein.

with a sharp scalpel introduced directly downwards, and then to divide it in a direction forwards, away from the vessel, with a blunt tenotome. There will also be less risk of this accident occurring, if the line of the tibia be clearly felt and taken as the guide for puncturing the fascia over the tendon. Unless great care be taken in cutting through the tendo Achillis, there is also some risk of wounding the artery; as, in bad cases of varus, these two structures lie nearly parallel to one another, the tendo Achillis being drawn out of the median line towards the inner ankle. Indeed, in one instance I have seen the posterior tibial artery punctured during the division of this tendon, or rather in an attempt to divide some tense bands that lay beneath it; the bleeding, which was very free and in a full jet, was however, readily stopped by pressure, no bad consequences resulting. The proper plan of treatment, when such an accident occurs, is, when the artery is merely punctured, to cut it completely across, and then to apply firm pressure, by means of a pad and bandage, over the bleeding orifice. Tamplin states that he has seen no ill effects follow this accident. If a circumscribed false aneurism form, it must be laid open, the clots turned out, and the vessel tied. No extension of the foot should be practised for some time in such cases, lest the coagulum be disturbed.

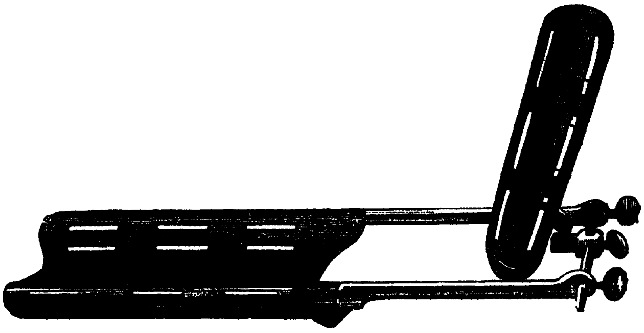


Fig. 540.—Aveling's Talivert.

In ordinary cases of varus, after a lapse of four or five days, Scarpa's or Little's shoe, or Aveling's talivert (Fig. 540), a most ingenious and useful instrument, allowing every movement necessary in club-foot, may be applied; or the foot may be well abducted by means of a wooden splint, fixed to the outer side of the leg, and provided with pegs, so placed that the toes can be drawn up, and the foot well turned out, by rollers and tapes attached to them.

**Talipes Valgus—Flat or Splay Foot.**—Is the antithesis to varus. In it there is a tendency in the first instance to obliteration of the arch of the instep, so that the sole becomes perfectly flattened; and, as the disease advances, a tendency to eversion of the foot usually takes place (Fig. 541). When it has advanced to this extent, the toes and anterior part are often somewhat raised, so as to constitute the variety termed **Calcaneo-valgus.** In talipes valgus the ligaments of the sole of the foot, which bind the bones together so as to form the arch, are weakened and elongated, and the peroneal and extensor tendons are commonly tense. In the more advanced cases, the foot becomes everted at the calcaneo-cuboid and astragalo-scaphoid articulations, and the head of the astragalus projects inwards, being as it were partially dislocated from the scaphoid. This being pressed upon, is often a source of much pain. Valgus is not so frequent a form of club-foot as the other varieties. It commonly affects only one extremity, being often met with in young adults, as the consequence of over-fatigue of the foot from long-continued standing, and from the habit of sliding the left foot in walking, or twisting it, so as to press upon the inner side. When both feet are everted, there is usually knock-knee as well; and then this affection is met with at a much earlier period of life.

*Treatment.*—In the earlier stages of acquired talipes valgus in young adults, more particularly in young women, the deformity may often be remedied by putting the patient under the influence of chloroform, forcibly drawing the foot inwards so as to overcome the tension of the peronei muscles, fixing it in a Dupuytren's splint, and afterwards restoring the arch of the foot by a convex sole in the shoe.

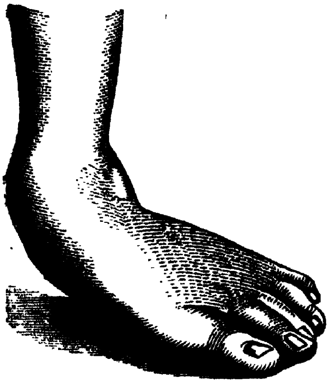


Fig. 541.—Talipes Valgus.

In the more confirmed cases, the treatment consists in the division of the tendons of the peroneus longus and brevis, behind the outer ankle; and of that of the extensor communis on the dorsum. Scarpa's shoe may then be applied, and the arch of the foot restored by wearing a pad under the sole for some considerable time.

In **Talipes Calcaneo-valgus** the projection of the heel backwards is obliterated, and the outer side of the foot curved round towards this, so that the little toe approaches the point of the heel. It is not a congenital affection; and, as it commonly arises from a partially paralysed state of the gastrocnemius, the treatment is not very satisfactory.

**Hollow Club-foot.**—As in the hand, the interossei not only move the toes laterally, but powerfully flex the first phalanges, at the same time that they extend the two last.

In paralysis of the interossei, and of the short flexor, and the adductor of the great toe, the toes take the constant position of a claw, *i. e.*, the first phalanges are extended upon the metatarsal bones, and the last two phalanges flexed upon the first under the influence of their antagonists the extensors of the first and last phalanges. These deformities are often complicated by paralysis or atrophy of some of the muscles of the leg, giving rise to various forms of club-foot.

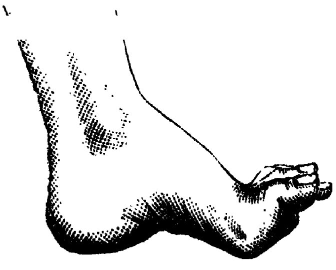


Fig. 542.—Hollow Claw-Foot.

There is a form of deformity of the foot, usually congenital, and not uncommon, the origin of which has remained unknown up to the present time. This is a variety of club-foot which Duchenne calls "hollow claw-foot," resulting from atrophy or paralysis of the interossei, and of the adductor and short flexor of the great toe. The accompanying diagram (Fig. 542) shows, 1st, that the first phalanges are extended almost to the point of being subluxated upon the head of the metacarpal bone, whilst the last phalanges are flexed upon the first and form thus a claw; 2nd, that the curve of the plantar arch is considerably increased. The origin of this "griffe pied creux" is as follows.

"When the interosseous muscles are paralysed or atrophied, the tonic contraction of the muscles which extend the first phalanges and that of the muscles which flex the last phalanges being no longer opposed, the claw-like condition of the toes gradually becomes augmented. The posterior extremities of the first phalanges are subluxated upon the heads of the metatarsal bones; then the curve of the plantar arch becomes increased and the plantar fascia shortened; then certain articulations and their ligaments become deformed, as in all club-feet." The mechanism is exactly the same as that of the similar disease in the hand.

This disease makes standing and walking very painful when too prolonged; for this reason, that from the position of the toes and from the increased arch of the foot, the whole pressure in walking is borne upon the heel and upon the skin covering the unnaturally prominent heads of the metatarsal bones, which latter becomes tender in consequence, especially that over the great toe.

In the case from which the drawing was made, the disease was congenital, but did not trouble the patient till he was ten years old. When he was apprenticed, a long walk always gave him pain, and at last he was obliged to lay himself up about one week in every month to get rid of his pains. Both feet were affected, but the left much less than the right. By galvanic examination, irritability was found to be entirely lost in the right interossei and very much diminished in the left.

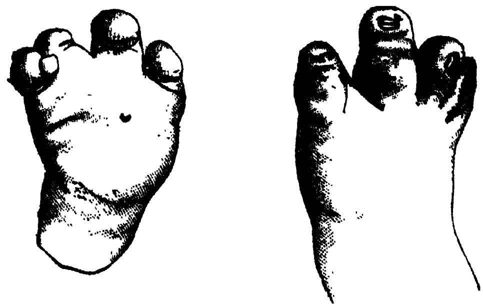
The disease is always accompanied by a tendency to talipes equino-varus, "that is to say, the flexion of the foot upon the leg during walking is incomplete, and during this flexion of the foot the tibialis anticus (flexor adductor) has a predominance of action over the extensor communis digitorum (flexor and abductor of the foot); or in other words, during flexion, the sole of the foot is turned slightly inwards and the dorsum outwards." However, by a careful examination, we find there is really no talipes equinus nor weakness in the muscle producing flexion with abduction. This is accounted for by considering the unfavourable conditions in which the long extensor of the toes is placed after paralysis of the interossei. The inferior attachment of this muscle is upon a movable point, the posterior and superior extremity of the second phalanx. The tendency to extension is counteracted by the interossei, which serve to give a fixed point for the extensor longus digitorum to act from, when flexing the foot at the ankle. But when these muscles are paralysed, the attachment of the extensor communis digitorum becomes very movable, and we then see at the moment of flexion of the foot upon the leg, that the first phalanges are drawn back even more than before upon the metatarsal bones, at the same time depressing the heads of these bones. The action of the long extensor as a flexor and abductor of the foot is thus much weakened, and this leads to a predominance in the action of the tibialis anticus (flexor and adductor of the foot), in consequence of which a mild form of varus is produced accompanied by some raising of the heel, due to imperfect flexure of the ankle-joint.

To sum up: this variety of hollow foot (pied creux) is produced by an exaggerated and continued action of the extensors of the first phalanges of the toes—extensor communis digitorum and extensor proprius pollicis, following on a weakness or feebleness of their antagonists—the interossei, adductor, and short flexor of the great toe. Consequently any excess of action of these same extensor muscles, whatever may be its cause, ought to produce exactly identical results.

The knowledge of this fact explains the origin of the hollowed claw-foot that we see produced in talipes equinus, when the long extensor of the toes has preserved its voluntary contractility; and it would be as well here shortly to consider the cause of the alteration in the foot in talipes equinus. As soon as the talipes commences to oppose the flexion of the foot upon the leg, the opposing muscles act with increased vigour to prevent the deformity. This leads to an abnormal extension of the first phalanges of the toes (to which the extensor longus and extensor pollicis are attached), and ultimately to a subluxation of these phalanges upon the dorsal surfaces of the heads of the metatarsal bones. Every attempt at flexion then depresses the heads of the metatarsal bones into the sole of the foot, so increasing the plantar arch. This is most marked in the great toe. The tonic force of the antagonists to the extensors is unable to withstand the exaggerated action of the long extensors.

That the mechanism here given is correct, may be shown by the following fact. In a well marked case of a patient affected with a "hollow claw-footed equinus" (griffe pied creux équin), we should see that any attempt to flex the foot at the ankle leads only to further extension of the toes, which become drawn back over the heads of the metatarsal bones, pressing them down and increasing the arch of the foot. Hence, so far from any raising of the extremity of the foot taking place, it is rather depressed.

The *Treatment* of this condition must be conducted on two principles: 1. The stimulation of the paralysed interossei, adductor, and short flexor of the toe by means of faradisation; and 2. The division of the tendons of those muscles which by their tonic contraction maintain and increase the deformity. Those which I have usually found it necessary to divide are the extensor of the great toe, the tendo Achillis, and in addition to these a very tight band of the inner division of the plantar fascia. The Scarpa's shoe that is used after the operation should have hinges across the middle and be provided with a rack-and-pinion movement, so that the depressed heads of the metatarsal bones may be raised by the anterior half of the sole.



Congenital Hypertrophy of Toes and Foot.
Fig. 543.—Plantar Aspect. Fig. 544.—Dorsal Aspect.

**Contraction of One Toe** is not of unfrequent occurrence. In this complaint the proximal phalanx is either on its normal level or slightly drawn up; the two distal are bent down at an acute angle, the apex of which is formed by the articulation of the first with the second. This contraction more commonly affects the second toe, is often symmetrical in the two feet, and is frequently a source of great inconvenience, and even permanent lameness. It appears to be due to contraction of the digital prolongation of the plantar fascia, and is best remedied by dividing this subcutaneously opposite the lower part of the second phalanx, and then straightening the toe.

**Supernumerary and Webbed Toes** are sometimes met with. It is comparatively seldom, however, that any operative interference is required in these cases. Should it be, the remarks that have been made at pages 364 and 365, in reference to the treatment of these conditions in the hand, are equally applicable here.

**Congenital Hypertrophy of the Toes and Foot**, as represented in Figs. 543 and 544, occasionally occurs. This malformation is of necessity incurable.

**Weak Ankles** not uncommonly occur in rickety children; the ligaments being relaxed, the joints appearing to be swollen, and the child being unable to walk or stand without great difficulty. In these circumstances, attention to the state of the general health, douching with salt water, with the application of an elastic India-rubber bandage round the ankle, or the use of light iron supports, will be found most useful.

# DISEASES OF REGIONS.

## CHAPTER LV.

## DISEASES OF THE HEAD AND NECK.

### DISEASES OF THE SCALP AND SKULL.

**The Scalp** is subject to all those surgical diseases that affect the common integument of the body. But it is more than any other part of the surface liable to two diseases, viz., Atheromatous and Nævus Tumour. These have already been so fully treated of in Volume I. (Atheroma, p. 737, and Nævus, pp. 759 and 934) that their description here would lead to needless repetition.

There is one form of disease peculiar to the scalp which has not yet been mentioned, viz., the Pachydermatous Tumour.

**Pachydermatous Tumour of the Scalp.**—This disease, of extremely rare occurrence, was first described by John Bell. It was first named and fully described by Valentine Mott as *Pachydermatocele*, more recently by Virchow as *Fibroma Malluscum*. The accompanying cut (Fig. 545), taken from a patient whilst in America, who was afterwards successfully operated on by W. Stokes, in Dublin, gives a good representation of the disease.

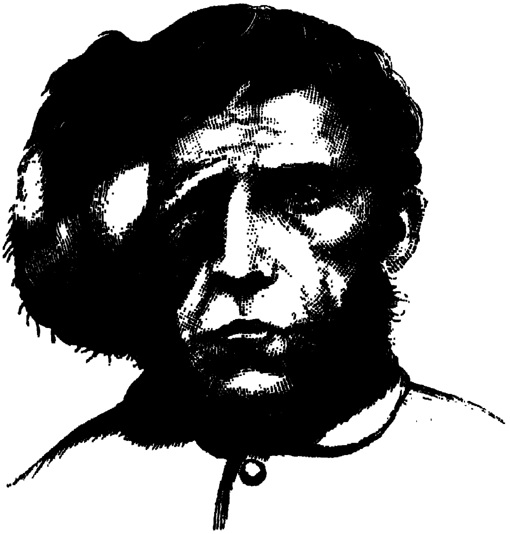


Fig. 545.—Pachydermatous Tumour of Scalp.

These tumours are neither painful nor dangerous, but their weight and the deformity occasioned by them render their removal desirable.

*Treatment.*—The removal of this tumour may be effected by the ligature or the knife. Pollock has successfully extirpated one by the former, W. Stokes by the latter method. But the operation is not without danger. In Stokes's case the hæmorrhage was described as terrific, and had to be arrested by the cautery, nearly costing the patient his life. Stokes states that in the whole course of his experience he had never seen such copious and uncontrollable "weeping" hæmorrhage; it came from every point of the cut surface.

**Fungus of the Dura Mater.**—Sometimes without external or apparent cause, at other times in consequence of a blow or fall, a *Fungous Tumour* grows from some part of the dura mater, usually on the top of the head or one of the parietal regions. As it increases in size, it produces absorption of the skull covering it; the bone becomes thin and expanded, and crackles like parchment on pressure, sometimes not being raised above its proper level, but more usually being pushed up by the pressure of the growth beneath, which at last protrudes under the scalp. More usually, this perforation of the skull is gradual; but in some cases it would appear to have been sudden, the first intimation that the patient had of disease being the presence of a tumour under the scalp. When the skull is perforated, the sharp edges of the circular opening can be distinctly felt; and the tumour which protrudes pulsates distinctly, as may be proved both by the finger and the eye.

*Symptoms.*—Symptoms of cerebral disturbance—double vision, loss of sight, deafness, or epileptic fits, with fixed pain in the head—usually precede for a considerable time the external appearance of the tumour. In some rare cases, no such symptoms have indicated the existence of intracranial disease; and the first evidence of the disease has been the sudden protrusion of a pulsating tumour through the skull. If the tumour be compressed, egg-shell cracking of the expanded and thinned cranial bones will be felt, and, if attempts be made to push it back under the bones, giddiness, syncope, and convulsions are produced. As the disease makes progress, death from paralysis and coma supervenes.

*Treatment.*—The result of the treatment of fungus of the dura mater is not very satisfactory; yet, as the disease appears to be almost of necessity fatal if left to itself, something should be attempted—not, however, until the tumour has fairly appeared through the bones. The scalp covering it should be turned back by a crucial incision, and the tumour exposed. The aperture in the skull through which it is protruded may then, if necessary, be enlarged by the use of the trephine or Hey's saw, so as to lay bare the full extent of the tumour, which must then be carefully dissected away from the dura mater.

**Fungus of the Skull** may occur. At first it closely resembles the disease just described; it differs from this, however, it being devoid of pulsation, and incapable of being pushed back. It appears to spring from the diploë of the skull, and may probably be of a myeloid, sarcomatous, or encephaloid character, sometimes secondary to primary deposits of a like nature elsewhere. In other cases it appears to be simply vascular, in structure resembling the pulp of a red gooseberry or a broken-down mulberry. In a case of this kind, which I had an opportunity of seeing many years ago, the growth was successfully removed by B. Phillips.

**Hernia Cerebri,** arising from wound or ulceration of the dura mater, has been already described (Vol. I., p. 556).

**Congenital Hernia of the Membranes of the Brain** is sometimes met with in the form of **Meningocele** or of **Encephalocele.** In the former, the protruded sac is filled with fluid: in the latter, it contains also cerebral substance. The diagnosis between these two conditions is generally difficult; and is of little practical importance. The disease is usually speedily fatal.

Z. Laurence finds that, of 39 instances in which it occurred, 21 were males, 18 females; that the protrusion may vary from the size of a pea to that of a tumour exceeding the child's head; and that the occiput is its chief seat—of 79 cases, 53 being in this situation. The hernia may occur at any of the unossified points of the skull; and has even been observed, in a case described by Lichtenberg, to protrude from the base of the skull through the mouth. In 6 instances, the subjects of this malformation reached an adult age; in all the remaining cases they died early, or were still-born. Surgery offers little in these cases; though in one instance Paget used injection of iodine with success; and in another, where sloughing of a portion of the tumour was taking place, Annandale applied a ligature to the peduncle, and removed the tumour, the child recovering completely in spite of an attack of measles. In another case, the portion of brain was successfully sliced off, the patient surviving.

**Tapping the Head.**—It occasionally happens in children afflicted with acute hydrocephalus, and sometimes, though more rarely, in cases of the chronic form of the disease, that the distension of the head and the compression of the brain by the intracranial accumulation of fluid threaten immediately the life of the patient.

In these circumstances, the only chance of life is the evacuation of the serum by tapping. This is best done by means of a fine trochar pushed in through the coronal suture, about midway down. The point of the instrument should be directed inwards and backwards, so as to penetrate the lateral ventricle, and thus to evacuate a portion of the contained serum. This should be done very gradually, so as not to disturb the circulation through the brain. After a moderate quantity of fluid has been withdrawn, the small aperture should be closed with a strip of plaster, and, if necessary, an elastic bandage should be applied round the head so as to compress and to confine the bones: this is more especially necessary in chronic hydrocephalus. It is scarcely necessary to observe that the prognosis in these cases is not of a very favourable character. In *chronic* hydrocephalus the operation can scarcely be expected to succeed, as all the structures, osseous as well as cerebral, have undergone organic changes. In the *acute* forms of hydrocephalus, immediate relief of the coma ensues on the withdrawal of the fluid, and there is just the possibility of the evacuation of the fluid permanently relieving the compression of the brain, whilst the small puncture is not likely to add to the mischief that is going on in the interior of the cranium.

## DISEASES OF THE EAR.

**Inflammation of the External Ear, Otitis, or Ear-ache,** is usually a rheumatic affection occurring in debilitated individuals, and is characterised by intense pain, generally associated with hemicrania; a kind of combination, indeed, of inflammation and neuralgia. This pain is much increased at night, by warmth of the bed, and is generally accompanied by throbbing and noises in the ear. The *Treatment*, at first antiphlogistic, generally and locally, may advantageously, after a time, give place to quinine and iodide of potassium, with the external application of aconite. Occasionally the affection runs on to the formation of abscess in one of the ceruminous follicles of the meatus externus, attended by excessively painful tensive throbbing. To relieve this, leeching, poulticing, and early lancing will be required.

**Otorrhœa.**—This is a fetid discharge of a muco-purulent character, usually occurring in strumous children, especially during dentition, and often associated with enlarged glands under the angle of the jaw. It may be of three kinds: 1, proceeding simply from the mucous surface of the external ear, apparently depending on subacute inflammation of it; 2, proceeding from the middle ear through a perforated membrana tympani, the mischief extending to and the discharge proceeding from the mastoid cells; 3, connected with necrosis of the petrous portion of the temporal bone, associated with disease and destruction of the tympânum, and necessarily of the internal ear. These discharges are especially apt to supervene in measles and scarlatina. Their *Prognosis* and *Treatment* will depend on their precise seat. When occurring from the external meatus only, however tedious, they are never dangerous. Attention to the state of the general health and to that of the teeth, with the use of lead, chlorinated or carbolised injections, will usually arrest them. When occurring from the middle ear, through a perforated tympanum, they are far more intractable and also more serious. Not only will hearing be impaired to a greater or less extent, but they may continue for an indefinite time, resisting all means of treatment. If they proceed from the mastoid cells and the internal ear they are far more serious, and the patient is exposed to a double danger. The dura mater covering the bone may become inflamed, and, the membranes at the base of the brain becoming irritated by the extension of the morbid action to them, convulsions, coma, and death usually at last result. This is especially the case when the petrous portion is the seat of disease. When the mastoid process is chiefly affected, phlebitis of the sinuses and the cerebral veins ensues, and pyæmia is developed, which proves fatal.

SPECIAL AFFECTIONS OF THE EXTERNAL EAR.—The external ear is occasionally the seat of special affections; thus in idiots, **Hypertrophy** of this structure is sometimes met with; and in gouty subjects, **Tophi,** or **Gouty Concretions,** are occasionally deposited in it. Paget, Bruck, and Vanzetti have described a **Fibrous Tumour** that occasionally forms in the lobule of the ear from the irritation produced by piercing it, and as "one of the penalties attached to the barbarism of ear-rings." These tumours are semi-malignant, like the warty growths of cicatrices; and, after excision—their only treatment—are somewhat apt to return.

**Bloody Tumours, or Hæmatomata,** are occasionally developed in the external ear of the insane or idiots. They may attain a large size, and are often multiple. Unless they become inflamed, I think it better to leave them untouched, when they will gradually be absorbed. If inflamed, they must be opened.

**Concretions in the Meatus.**—We not uncommonly find that the meatus becomes blocked up by accumulations of wax, dark, indurated, and pipe-like, or forming balls and masses that lie in contact with the membrana tympani. These chiefly occur in individuals of the bilioso-phlegmatic temperament, and are a common source of temporary deafness among young people. They not only materially impair the sense of hearing, but are very apt to give rise to noises in the head, and to crackling sensations on opening and shutting the mouth. Their presence is best ascertained by examination with a well-constructed ear-speculum; that introduced by Toynbee, of a double-convex shape, is the most useful. The *Treatment* of these concretions consists in softening the wax by the introduction of a little glycerine into the ear for a few nights, and then repeatedly washing out the meatus by the injection of tepid soap and water, or water containing a little soap-liniment, thrown in with a large syringe; as the fluid regurgitates from the membrana tympani, it will at length bring away dark and hardened ceruminous masses.

**Polypi** are met with, situated deeply on one side of the meatus. They are usually hard and fleshy-looking, though sometimes soft and gelatinous, as in the nose; sometimes pediculated, but at others situated on a broad base. They produce serious inconvenience by obstructing the external ear, and require to be twisted off by means of forceps, or, if too firmly fixed for this, cut off with scissors or a wire snare; the surface from which they spring should then be touched with nitrate of silver, so as to prevent a recurrence of the growth.

**Thickening of the Cuticle.**—Occasionally the cuticle of the external ear, and that covering the membrana tympani, becomes thickened and indurated, assuming a dull white appearance: this condition may give rise to some amount of deafness. In these circumstances, glycerine, citrine ointment, or solution of nitrate of silver, will be extremely useful in restoring the healthy action of the integument of the part.

**Deafness.**—It is not my intention to enter into the general pathology of the various kinds of deafness, nor to discuss its causes. It may be stated generally, however, that it may arise from obstruction of the external ear from disease; from ulceration and perforation of the membrana tympani; from various inflammatory affections, chiefly of a subacute and chronic character, of the internal and middle ear; from paralysis of the acoustic nerve, either local or dependent on cerebral lesions; and lastly, from obstruction in the Eustachian tube, or from disease of the throat. Toynbee has especially shown that many cases of so-called "nervous" deafness, together with singing, ringing, boiling, and other noises in the head, are in reality dependent upon chronic inflammatory affections of the internal and middle ear; and that the treatment best adapted for their cure consists in constitutional and local means of an alterative and antiphlogistic character.

## DISEASES OF THE NOSE AND CHEEKS.

**Chronic Catarrh,** in the form of a thin watery mucous discharge, lasting for many months, is occasionally met with, more particularly in young women, independently of any structural disease of the mucous membrane. The *Treatment* of this affection consists in the employment of tonics and means calculated to strengthen the system generally, and the local application of astringents, such as tannin, chloride of zinc, &c. But under any plan of treatment this affection is apt to prove rebellious.

**A very Fetid Discharge** from the nose will occasionally occur in delicate and unhealthy children while cutting their teeth, and may continue for several years. It is not attended by ulceration of the mucous membrane, but appears to be due to some modification of the nasal mucus, connected with protracted and faulty dentition. The *Treatment* should be directed rather to the teeth and stomach than to the nose.

**Epistaxis**, or bleeding from the nose, is very common in children and in young people about the age of puberty, more particularly in girls, antecedently to the menstrual period; it may either be active or passive, but is most usually dependent on congestion of the mucous membrane. But in the adult it is more serious, and it may then be associated with and dependent on two very opposite conditions—either on a state of plethora with tendency to cerebral congestion, or on an anæmic and cachectic state, in which the blood is thin, and does not coagulate readily. In the first condition the epistaxis is often connected with congestion of the liver, and, when occurring in the young and plethoric, it is often a salutary relief to the system. But when occurring in cachectic and anæmic people, more particularly in persons advanced in years, it becomes of very serious moment; and in such circumstances the loss of blood may be so continuous and copious that, unless active means be adopted, a fatal termination may ensue, the hæmorrhage being truly arterial. When epistaxis proves fatal, it is by its constant recurrence. In these cases, I believe, the nasal hæmorrhage is always associated with a broken-down and unhealthy state of the blood, dependent upon chronic visceral mischief, especially disease of the kidneys and liver. The worst and most intractable cases that I have seen have been connected with hepatic disease and jaundice.

*Treatment.*—Epistaxis must not be treated simply as a local disease of the nose. It is usually only a symptom of some constitutional condition that requires remedying before the hæmorrhage can be expected to cease. Hence it is of the first importance to treat on ordinary medical principles those states of plethora or cachexy with which it may be associated, or those conditions of disease of liver or of kidney that are met with in persons suffering from it.

In young people, otherwise healthy, and in slighter cases, epistaxis may commonly be arrested by the employment of ordinary domestic means, such as the application of cold to the nape of the neck and forehead; and its return may be prevented by the use of purgatives, or by attention to the proper regulation of the menstrual function.

In plethoric adults the flow should not be too suddenly checked. Should it prove very abundant, dry cupping between the shoulders, and the application of an ice-bag to the forehead, with rest, will be required.

In anæmic and cachectic subjects, and in old people, the hæmorrhage is often attended by dangerous consequences, and requires the use of active measures for its suppression. In these cases the following plan should be adopted. The head should be raised, an ice-bag applied to the forehead, complete rest and quietude enjoined, and gallic acid in ten-grain doses, or half-drachm doses of the tincture of ergot, administered at frequent intervals. Should the bleeding still be profuse and continuous, the interior of the nose may be sponged out with a solution of perchloride of iron or tannin. If this do not suffice, it will become necessary to plug one or both nostrils. This is best done by means of a plug of prepared sponge, having a quill or a piece of gum catheter passed through it for breathing purposes, and soaked in a solution of perchloride of iron.

Should, however, the hæmorrhage still continue, the blood forcing its way backwards into the throat, or perhaps being swallowed, the posterior nares require to be plugged as well. This is best done by carrying a long piece of strong whip-cord along the floor of the nose through the posterior nares into the pharynx, by means of Bellocq's sound (Fig. 546), or, if this be not at hand, by threading the cord through an elastic catheter, and carrying this into the pharynx, then seizing the cord as it appears behind the soft palate, and drawing it forwards into the mouth, at the same time that the catheter is taken out of the nostril. In this way the string will pass through the nose, round the back of the soft palate, into and then out of the mouth (Fig. 547). To the centre of the piece of string that hangs out between the lips, a plug of lint, about the size of the first joint of the thumb, or better still, a piece of compressed sponge, should be firmly tied; this is then drawn up into the posterior nares by pulling on the end of the ligature that hangs from the nose, being guided in its passage behind the palate by the fingers introduced into the mouth. When the bleeding has ceased, it may readily be withdrawn by means of the string that hangs out of the mouth. As the epistaxis is very apt to recur, it is a wise precaution, when the plug is removed from behind the palate, to leave a loop of string in the nose and mouth, which may be knotted and fixed by a slip of plaster behind the ear. In this way the plug may, if occasion occur, be readily replaced without the necessity of re-introducing the sound or catheter through the nose, which is often a troublesome operation.

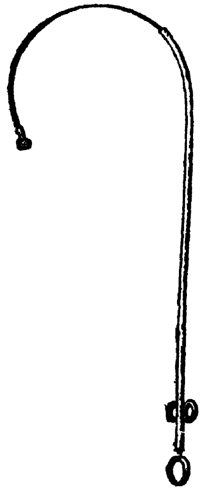


Fig. 546.—Bellocq's Sound.

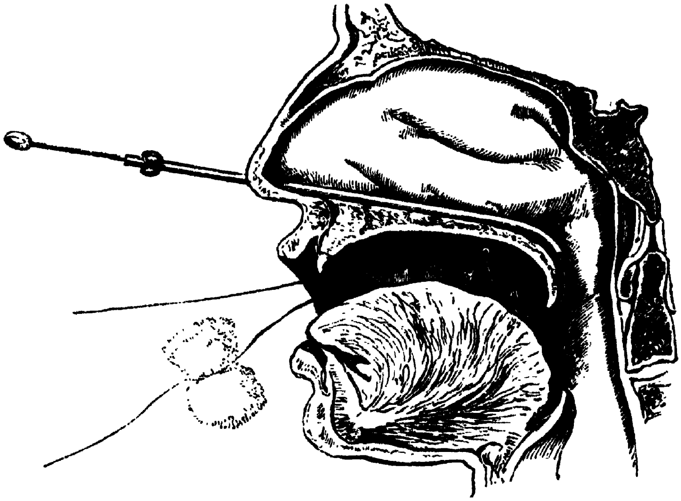


Fig. 547.—Diagram of Plugging the Nostril by means of Bellocq's Sound.

**Chronic Thickening of the Schneiderian Membrane.**—The mucous membrane of the nose is not unfrequently chronically inflamed, especially in strumous children; that portion of the membrane covering the turbinate bones becoming thick, soft, and vascular, and projecting like a broad fringe from their surface. It is usually of a bright red colour, and covered with muco-pus. This swelling at all times produces snuffling and a peculiar intonation of voice, but increases in wet weather, and then may become so great as seriously to obstruct the breathing.

The *Treatment* consists in attention to the general health ; more specially to the eradication of the strumous diathesis. Much benefit may also be derived from the local application or injection of astringents, as a strong solution of the nitrate of silver applied by means of a camel's-hair brush, and sulphate of zinc and oak-bark lotions snuffed up, or injected by means of a proper syringe. In many instances, when the disease occurs in strumous children, change of air will effect the greatest amount of benefit.

**Abscess** occasionally forms either on the mucous membrane or on the septum, and thus may lead to necrosis of the cartilages and bones, separation of these, flattening of the nose, depression of its bridge, and great deformity. These various forms of abscess, followed by necrosis, are commonly syphilitic, and then are associated with ulcers and a foul and fœtid discharge, which has a tendency to cake upon their surface, forming dark and rugged crusts, and constituting the different kinds of *Ozœna.* The septum may be the seat of chronic ulceration consequent upon the irritation of decayed teeth, producing disease of the antrum, and escape of morbid secretion from this into the cavity of the nose.

The *Treatment* of these conditions must be conducted by the local application of nitrate of silver, black wash, and the chlorinated lotions ; the general treatment consists usually in the administration of the dilute mineral acids, iodide of potassium, and sarsaparilla.

**Ulcers** and **Fissures**, of a less serious character, though very painful and chronic, often occur at the angle of the ala and septum, or between the ala and tip. Their *Treatment* consists in touching them from time to time with nitrate of silver, or in the application every night of white precipitate or citrine ointment ; at the same time that the general health is attended to, cachexy removed, and the strength restored, by the administration of iron, bark, and sarsaparilla.

**Necrosis** not unfrequently occurs in the loose bony structures lying in the nasal fossæ or in the nasal bones themselves. In these cases the septum nasi participates in the morbid action, and commonly separates or is perforated.

Necrosis may occur in these situations either as the result of syphilis, the abuse of mercury, or from external injury. I have, however, seen cases, more particularly in women and children, which are not referrible to any of these causes, or indeed to any other external exciting cause, and in which scrofula was probably the occasion of the disease.

The presence of the necrosis may be suspected from the great fœtor that infects the breath—the characteristic odour of dead bone being emitted, but in an excessive degree ; and its existence may always be positively determined by exploration of the nasal cavities with a probe.

The *Treatment* is simple, and must be conducted on ordinary medical and surgical principles. If the general health be impaired, or if the disease be specific, appropriate alternative constitutional treatment must be adopted. The fœtor may be lessened by the injection or snuffing up of disinfecting liquids, more particularly the chlorides and permanganates. So soon as the bone is loosened, it must be extracted with polypus-forceps, coming away in soft black crumbling, offensive masses. There is often abundant hæmorrhage after this extraction, but I have never had serious trouble given in these cases; plugging may possibly be required if cold do not arrest the bleeding.

**Lipoma** is a chronic hypertrophy of the cutaneous and subcutaneous structures, and of the areolar tissue of the nose, forming a large reddish-blue, vascular-looking, soft, tremulous, and lobulated mass, enveloping the end of the nose, and producing excessive deformity of it. There are all degrees of this disease, from mere clubbing of the end of the organ, to the formation of a set of pendulous lobular tumours attached to it. The sebaceous glands and crypts appear to be the structures chiefly implicated in this disease. The patient's appearance may be greatly improved by the removal of these growths. This may be done readily enough by making an incision down the mesial line to the alar cartilages, and then dissecting the lipoma off these on each side; especial care, however, being taken in doing this not to encroach upon the nostril. This is best avoided by directing an assistant to keep his finger in it while the dissection is being prosecuted, so that he may warn the Surgeon of the too near approach of the knife. The surface is then left to granulate and cicatrise.

**Lupus and Epithelial Cancer.**—The nose is frequently the seat of *Lupus* and various forms of *Epithelial Cancer*, many of the deformities of this feature being referrible to this affection; indeed, lupus may be looked upon as almost specially affecting this organ, destroying one or both alæ, the columna, or perhaps the whole of the nose. The consideration of the nature and treatment of these affections in this situation presents nothing special (*see* Chapter xxxvii. Vol. I.): but the cure of the deformities induced by them, which is full of interest to the Surgeon, will be considered in detail when we speak of the plastic operations that are practised on the face.

POLYPUS.—Tumours of very different structures and composition are met with in the nostrils; and to all of these which possess the common characters of being pendulous and blocking up these passages, the term *Polypus* is given. Thus Surgeons commonly speak of the *Benign*, the *Soft*, the *Gelatinous*, or *Mucous Polyp*, as well as the *Sarcomatous* or *Fleshy*, and the *Malignant Polyp*. The term, however, should properly be confined to a soft and pendulous mucous growth; the fleshy and malignant polypi being mere varieties of fibrous myeloid or encephaloid tumours, springing from the bones in the nasal fossæ, or from the ethmoidal and sphenoidal cells.

The true **Mucous Nasal Polyp** is a soft, moist, gelatinous tumour, of a greyish-yellow colour when lodged in the nasal fossæ; but when it descends into the anterior nares, or beyond them, and is exposed to the air, it becomes of a reddish-brown or purple tint, and somewhat shrivelled on the surface. It is usually lobulated, pedunculated, or bottle-shaped; and not very vascular except at the root, where it is permeated by largish thin-walled vessels that bleed freely on the slightest touch. In structure it is homogeneous, and composed of the elements of mucous membrane, covered by ciliated epithelium, the cilia of which may often be seen under the microscope in active movement after the removal of the growth. Occasionally polypi are found, growing from the lower part of the nares, covered with tessellated epithelium. The tumour may grow from any points of the surface of the turbinate and ethmoid bones, and has indeed occasionally, though very rarely, been observed to project into the nose from the frontal sinuses and antrum. Most frequently it grows from the inferior spongy bone towards the outer side of the nostril, sometimes from the roof of the nares, but never from the septum. The polypi are usually numerous and of all sizes ; as they increase they commonly extend forwards into the anterior nares, but, when large, they may be seen to reach into the posterior fauces, hanging down behind the palate.

*Symptoms.*—The symptoms occasioned by the presence of nasal polypi depend on their interference with respiration and speech, and on the visual changes which they occasion. The respiration through the affected nostril is impeded, the patient being unable to blow through it when directed to do so, and his speech is thick and nasal. There are snuffing and mucous discharge from the nostril : and all these symptoms are worse in damp than in dry weather. On examining the interior of the nose, by opening the nostril widely with the forceps or nasal speculum (Fig. 548), and then directing the patient to blow down, the lower end of the polyp may be distinctly seen, and, if large, will descend to a level with or even beyond the nasal aperture. By the introduction of a probe, the size and extent of the tumour, together with the position of its pedicle, may be readily ascertained. As it grows, it impresses changes on the shape of neighbouring bones, producing expansion and flattening of the nose ; it induces caries of the spongy bones ; and, interfering with the flow of tears down the nasal duct, occasions a watery state of the eyes, which, together with the change of shape in the features, and the peculiar character of voice and respiration, enables the Surgeon at once to recognise the nature of his patient's disease. Polypi chiefly occur in young adults after the age of puberty : but they are not unfrequently met with at later periods of life.

Their *Causes* are very obscure. Most commonly they are referred either to a blow or to a prolonged catarrh. They are more common in women than in men.

*Diagnosis.*—1. Mucous nasal polypi may be distinguished from *chronic thickening of the mucous membrane covering the spongy bones,* by the absence in the latter of any pedunculated growth around which a probe can be passed, by the florid red character of the thickened membrane, and by the fact that the subjects of this thickening are almost invariably strumous children. 2. In *abscess of the septum,* the history of the case, and the fact of the polyp never being attached to this part of the nose, will establish the diagnosis. 3. There is a peculiar malformation, consisting in a *deviation of the septum* to one side, that may at first be a little puzzling ; but here the examination of both nostrils, and the discovery of a depression of one side of the septum corresponding to the projection on the other, will reveal the true nature of the case. 4. The *fibrous and malignant tumours* of the nostril will be found to differ sufficiently in consistence and appearance from the ordinary polypi to prevent their being confounded with them in many cases ; yet in some instances much care will be required in coming to a definite opinion as to their true nature.

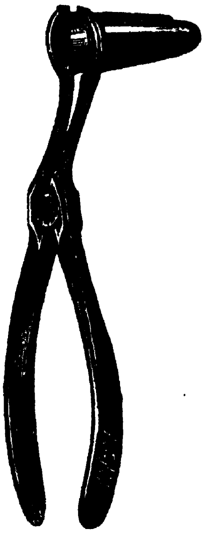


Fig. 548.
Nasal Speculum.

*Treatment.*—The spontaneous separation and expulsion of nasal polypi is of rare occurrence. I have, however, seen one case in which, after the assiduous use of chloride of zinc injections, a very copious discharge of large sloughy polypoid masses took place from one nostril which had been blocked up by them for many months previously, and from which they had even descended into the pharynx.

Nasal polypi may generally be most readily removed by avulsion with forceps; occasionally, but rarely, when they are very large, with a broad base, and especially when they extend into the throat, they require the application of the ligature. In removing these growths by the *forceps*, instruments of good length but very slender construction should be used,—those generally sold are too thick; the interior of the blades should be properly serrated, and have a longitudinal groove, so that the root of the tumour may be tightly grasped. The patient should be made to sit on a rather low chair; and, as there is generally a good deal of bleeding, a towel should be pinned over his clothes, and a basin placed before him to receive the blood and expectorated matters. The Surgeon then, having ascertained by the introduction of a probe, or by means of the blades of the forceps, the situation of the pedicle of the polyp, grasps this firmly and pulls it off with a twisting movement of the hand. He proceeds in this manner, twisting off rather than pulling away polyp after polyp, until the whole of the nostril is cleared, which may be ascertained by examination, and by directing the patient to compress the sound and to blow through the affected side of the nose. The bleeding, which is often very free, stops on the application of cold water. At about the end of a fortnight the patient should be examined again, as it not unfrequently happens that small polypi, which had been prevented from descending into the nares by the presence of the larger ones, now come down and require removal. These procedures must be had recourse to from time to time, until all tendency to fresh formations of this kind has ceased.

The *ligature* is chiefly required for those polypi that pass into the pharynx through the posterior nares. They may best be tied by passing a loop of strong whipcord, by means of a double cannula, through the nose; and then, after expanding the noose round the tumour in the throat, and making it grasp its pedicle, knotting it tightly. In some instances the polypi attain a great size, producing absorption of the nasal bones, and of the nasal process of the superior maxilla. In such cases it may be necessary, in order to extract them, to slit up the nose, and clip away with forceps the osseous surface from which they spring.

**Naso-pharyngeal Tumours.**—When the tumour, more especially if fibrous or fibro-plastic, hangs down in the pharynx behind the soft palate, its pedicle may be ligatured by conveying a thread through the nostril by means of a Bellocq's sound, and attaching to this a loop of silver wire, which, as it is withdrawn through the nostril, embraces the base of the tumour. The noose may then be tightened by twisting up the ends of the wire, or by running a silver cannula along them.

The intranasal fibrous tumour (sarcomatous or fleshy polypus) is usually attached to the posterior part of the nasal septum, descending to the pharynx. It is globular, smooth, firm, and has little disposition to bleed or ulcerate. It may grow to a large size, extending into the throat, and perhaps finding its way from the nose into situations where it is little expected. Thus it has been met with in the pterygo-maxillary fossa, and has been known to pass into the orbit through a hole in its inner wall. (See also Chapter LVII.)

**Malignant Nasal Tumours.**—There is a remarkable and as yet undescribed, and to me inexplicable, connexion between the ordinary benign nasal polypus and tumours of a sarcomatous, myeloid, or cancerous character, developing as a sequence of the extraction of the polyp in the large cavities and interosseous fissures in the vicinity of the nares. I have several times seen in children and young adults tumours of the above-mentioned character developing rapidly in the orbit, the sphenoidal cells, or behind the superior maxilla, after the extraction of perfectly and anatomically benign nasal polypi. The questions to be solved are these :—Are these tumours the result of the irritation of the operation of extraction ? or are they the primary disease lying concealed and undeveloped in the deep cavities of the face, the benign nasal polyp being secondary in reality, though more apparent, and consequent on the irritation set up by the graver and yet latent tumour ? In whatever way future investigators may answer this, the fact remains certain, that a connexion does exist between the two forms of disease. I have several times observed it.

Tumours of rapid growth, malignant in their course, (sometimes called malignant polypus,) either epithelial, encephaloid, or fibro-plastic, occasionally form primarily in the middle or posterior nares. They grow rapidly, with great expansion of the bones, much discharge, often intense tensive pain, and bleeding, the hæmorrhage being often excessive. They attack children and persons advanced in life. A tumour of this kind may be developed in different situations. Thus, in some cases, it extends into the pharynx behind the soft palate ; in others it has a tendency to press against, absorb, and protrude through the nasal or lachrymal bones, occasioning obstruction of the nostril, divergence and protrusion of the eyeball, with disturbance of vision, and severe neuralgic pains in the head and face. A soft elastic tumour that projects at the inner side of the orbit, extending into the nose and some little distance down upon the cheek, absorbing and destroying the bones on which it lies, and giving rise to secondary deposits under the angle of the jaw, will soon show its true nature. These diseases, especially when occurring in young people, speedily prove fatal. Death may occur in various ways, according to the nature of the growth, and the direction of its development ; by exhaustion from hæmorrhage ; by the implication of the brain and its membranes ; by asphyxia ; or by constitutional cachexy.

*Treatment.*—It is seldom that anything very effectual or permanent can be done by operation ; and it should be borne in mind, that some of the malignant growths which project into the nostrils take their origin from the sphenoidal or ethmoidal cells, or even from within the cranium, and that the nasal portion is only the external protrusion, as it were, of a deeply seated tumour. Should the tumour be slow in its growth, with an absence of secondary deposits, the Surgeon may endeavour to extirpate it by laying open the side of the face freely, making an incision from the inner angle of the eye down the side of the nose, and then across the cheek, dissecting up this triangular flap, cutting across the superior maxilla above the line of the alveoli, with a narrow-bladed saw and cutting pliers, and then in a similar way into the orbit beyond and through the nasal bones, and the nasal process of the superior maxilla above the tumour, and thus extirpating the growth. In this operation there is often free bleeding, which may be arrested by the actual cautery, and by pledgets of lint soaked in the perchloride of iron, which have the additional advantage of destroying any portions of the tumour left behind in the irregular and cellular cavities of this region.

**Naso-Orbital Tumours** are growths that, commencing in the posterior part of the nasal fossa or in the ethmoidal cells, perforate eventually the thin inner wall of the orbit and expand into the interior of that cavity, displacing the eye forwards, downwards, or outwards, in two, sometimes in all three of these directions. Vision is often but little if at all disturbed. The nostril on the affected side is blocked up by a polypoid growth. But the outline of the superior maxilla and of the hard palate is normal, no projection of the bone, in whole or in part, being perceptible. In fact, the disease and the deformity produced by it occupies a part of the face which is above a horizontal line drawn across the cheek on a level with the upper or orbital border of the superior maxilla. The disease always commences primarily in the nose or in the cavities contiguous to it. The extension into the orbit may not occur for many months after its primary development.

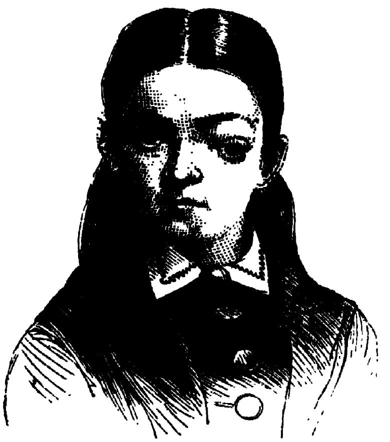


Fig. 549. - Naso-Orbital Tumour.

It occurs at all periods of life, from early childhood to commencing old age. At first it may present the ordinary characters of benign nasal polypus. This is removed, recurs rapidly, is again removed, with much hæmorrhage, and then the orbital implication is developed.

The *Diagnosis* of the naso-orbital from the naso-pharyngeal tumour may be made by observing the displacement of the eyeball and absence of all tumour behind the soft palate in the first case ; whilst, in the other, the naso-pharyngeal, the orbit is intact, while the upper part of the pharynx is occupied by a morbid growth, and the superior maxilla is possibly pushed bodily forwards or to one side. In the naso-orbital tumour, the deformity is above the horizontal line of the upper edge of the superior maxilla ; in the naso-pharyngeal, it is below this.

The nature of the tumour varies. It is usually a large or small spindle-celled sarcoma, but it may be truly cancerous.

*Treatment.*—The operation for the removal of naso-orbital tumour may be done as follows. An incision should be made from the nasal process of the superior maxilla directly down along the side and round the ala of the nose, so as to open the nasal cavity. The soft parts on the orbital side of this cut are then dissected down into the orbit. One blade of a cutting pliers being passed into the nose, the nasal bone is cut through directly upwards along its outer border.

An oblique cut upwards should then be made across the upper and inner part of the superior maxilla deeply into the orbit, the cut bones widely separated, and the nose turned completely over to the sound side of the face. The tumour at the nasal side of the orbit may now be felt, the eye being held to the outer side and protected with a retractor, without its capsule being opened. The orbital tumour may now be enucleated with the finger and curved scissors. The nostril is then cleared by means of polypus-forceps. The bleeding should be arrested by plugging; and, after all the morbid growth has been fairly extirpated, the nose should be pushed back and moulded into shape. The soft parts are then brought together with a few points of suture. Care must be taken in this, as all similar operations, that blood does not find its way into the trachea.

But occasionally the disease has extended into the integuments at the inner angle of the eye. Then the operation becomes more complicated. The following cases, operated on by me at University College Hospital, are good illustrations of this operation.

The first case was one of the most marked epithelial character, springing deeply from the ethmoidal cells, passing out through the lachrymal bone and the orbital plate of the superior maxilla into the orbit, blocking up the right nostril, and extending some way down the cheek, overlying the superior maxilla. It was growing rapidly in a woman 44 years of age, and required extensive removal of the bony structures in the situation from which it sprang.

The next case was one of a woman 64 years of age, in whom a fibro-plastic tumour developed with great rapidity in the situation of the lachrymal sac, invading the nose and orbit, and destroying the upper and inner part of the superior maxillary bone. The eye was pushed outwards, the eyelids became implicated at their nasal third, and an ulcerated opening formed over the centre of the tumour. Its growth was attended by very severe tensive pain. The operation consisted in dissecting away the diseased part of the integument, including the nasal third of each eyelid, then turning down a flap from the cheek and cutting away with pliers the osseous structures, including the inner part of the floor of the orbit, a considerable portion of the superior maxilla, and part of the nasal bones. In order to repair the gap made by the removal of diseased skin at the side of the nose and by the removal of so large a portion of the eyelids, a flap of integument was dissected off the bridge of the nose and glided over the aperture, to the edges of which and to the eyelids it was fixed by metallic sutures. Good union took place, and the patient made an excellent recovery. The immediate effect of the operation in both these cases was to relieve the patient of the agonising pain, previously occasioned by the tension in the bones of the face produced by the growth of the tumour.

Busch has described a case, in which the patient, a man aged 78, had a malignant tumour of the size of a fist, occupying the middle of the face. The symptoms at the commencement were those of nasal polypus. In removing it, it was necessary to cut close to the cribriform plate of the ethmoid bone, and as far back as the posterior nares. A flap of skin was transplanted from the forehead, not so much to form a new nose as to cover in the cavity left. The patient was able to leave the hospital in a few weeks.

**Calculi** are occasionally met with in the nasal fossæ, where they simulate foreign bodies; and here extraction may be practised with a pair of forceps. But sometimes these *rhinolites* are situated under the mucous membrane. In two cases I have dissected round calcareous bodies of this kind, of about the size of cherry-stones, from under the mucous membrane of the ala of the nostril in children.

THE FRONTAL SINUSES, though rarely, are occasionally the seat of disease. **Abscess** may form here, with much pain and expansion, and possibly caries of their anterior wall, attended by the local signs of inflammation and by danger of concomitant inflammation of the membranes of the brain. In such circumstances it may be proper for the Surgeon to remove by a small trephine the anterior wall of the sinus, and thus give exit to the retained pus. In other instances, again, the anterior wall of the sinus may be necrosed and perforated, the aperture being felt under a puffy tumour of the scalp. Here also the trephine is required. **Distension with serous fluid** has also been described as having occurred in some cases. There are a few cases recorded in surgical writings, of **Polypi** springing from these sinuses, and finding their way down into the nose after producing expansion of it and much inconvenience. Here likewise the propriety of trephining and so extracting the morbid mass would have to be considered.

TUMOURS AND ULCERS OF THE CHEEKS.—The cheeks are occasionally the seat of **Encysted Tumours** and **Cancerous Growths**, either springing from their inner surface, or taking their origin as **Lupoid Ulcers** on the outside. The *Encysted Tumours* in this situation may readily be removed by a little simple dissection. If they be attached to, or lie close under, the mucous membrane of the mouth, they may be dissected out from within, without interfering with the cutaneous structures. *Cancerous Ulcers* and *Tumours*, such as is represented in Fig. 550, seldom admit operative interference.

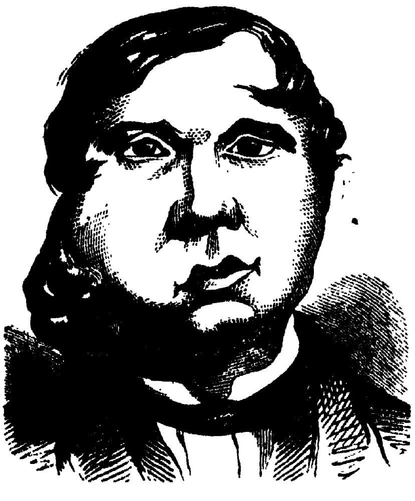


Fig. 550.—Cancerous Ulcer of Cheek.

**Salivary Fistula.**—One of the most troublesome surgical affections situated in the cheek is *Salivary Fistula*, occurring in consequence of injury, abscess, or operation, by which the parotid gland or duct has been opened, so as to cause a trickling of saliva through the external aperture made into it. The flow of saliva in these cases is always to a great extent and often entirely intermittent, ceasing in the interval between meals, and becoming very abundant during mastication.

The *Treatment* is by no means satisfactory, the attempt at union of the opening in the cheek being frustrated by the escape of saliva through it. If the fistula be very small and recent, the electric cautery may be employed with success; or the external aperture touched from time to time with a pointed stick of nitrate of silver. Should these means fail, the fistula having become chronic, operative measures will require to be put in practice. The closure of an old salivary fistula in the cheek is a very troublesome matter. In these cases the Stenonian duct appears to be obstructed or partially closed; and it is useless to attempt to occlude the opening in the cheek until a proper aperture for the escape of the saliva has been made into the mouth; the escape of a few drops of saliva through the fistulous opening rendering the attempt to close it completely nugatory. The plan of treatment which I have found to answer best is a modification of Desault's. It consists in passing a small hydrocele trochar into the fistula in the cheek, pushing this obliquely forwards and inwards into the mouth, as nearly as possible in the direction of the parotid duct, withdrawing the stilet, and then passing a small silk seton through the cannula, so as to bring one end out of the mouth, and the other through the fistula in the cheek. The cannula is then withdrawn, and the seton tied loosely. It should be left in for about three weeks, so as to establish a sinus into the mouth. It is then to be cut and withdrawn, and the sinus in the mouth kept patent by the daily introduction of a probe, by leaving a small piece of gum catheter in it, or, if it show much disposition to close, by the introduction of a laminaria tent. In this way the saliva is diverted from the external opening and made to flow into the mouth. The external aperture in the cheek may now be closed by touching its edges with a pointed stick of the nitrate of silver or the galvanic cautery; or, if large, they may be pared and stitched together.

## DISEASES OF THE LIPS.

**Congenital Malformation of the Lips** is of common occurrence. *Congenital Contraction*, or even complete closure of the orifice of the mouth, has been met with at birth; such a condition must be remedied, according to circumstances, by the skill of the Surgeon. By far the most common malformation, however, is the condition termed *Hare-lip*, which will be noticed in detail in the chapter on the Plastic Surgery of the Face and Mouth.

**Hypertrophy** to a great extent occasionally occurs in either or in both lips. It is often of an œdematous character, being kept up by the irritation of fissures or cracks; if so, these must be cured, when the size of the lip will gradually diminish. Sometimes, however, it becomes permanent, continuing after the cure of the fissure; in these circumstances it may be necessary to excise an elliptical portion of the mucous membrane of the lip in a horizontal direction, and then to bring the edges together by means of sutures or pins.

**Ulceration** is not unfrequently met with on the prolabium, frequently of a simple character, though chronic. It is often dependent on a disordered state of the digestive organs. It will commonly yield to the application of nitrate of silver, to proper constitutional treatment, having for its object the improvement of the digestion, and in very chronic cases to the administration of the preparations of arsenic.

**Encysted and Erectile Tumours.**—The lips may be the seat of encysted and erectile tumours, requiring extirpation by the knife or ligature. In dealing with these, the Surgeon must be guided by the circumstances of the individual case; but he should, if possible, avoid cutting through the whole thickness of the lip; and, if compelled to do so, he must act as will be described in speaking of cancer of this region. (See next page.) These growths most frequently occur on the lower lip.

*Encysted Tumours* are usually small and transparent, with thin walls, containing a glairy straw-coloured fluid. These should always be dissected out; mere excision of a portion of the wall being followed by recurrence of the disease.

*Erectile Tumours* of the lip are usually of an active character, and may either be excised, if of moderate extent and implicating the whole thickness of the lip; or, if of large size and projecting from the mucous surface, they may be safely ligatured (p. 940, Vol. I.) I have had under my care several cases of *Nævus* of the upper lip, implicating the whole substance of the part, and have successfully removed them by the repeated application of potassa cum calce.

MALIGNANT DISEASES OF THE LIPS.—Not unfrequently *Warty Growths* and various forms of *Epithelioma* and *Cancroid Diseases* appear upon the lips. These affections are not removable by therapeutic means, and require surgical interference.

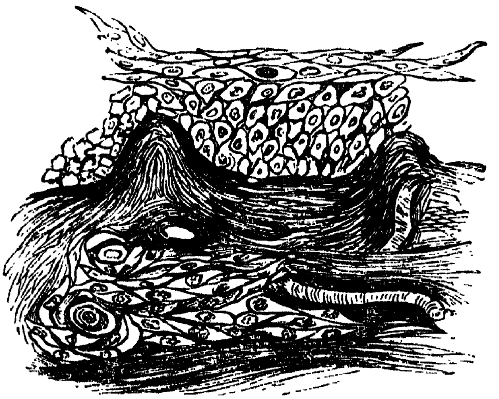


Fig. 551.—Section of an Epithelioma of the Face, showing the formation of Epithelial Cells within the substance of the true Skin.

The structure of epithelioma has been so fully described at p. 810, Vol. I., that it need not detain us here. The accompanying cut is a good illustration of the microscopic characters usually presented by it in the face and lips.

**Epithelioma** of the lip either commences as a warty growth, which gradually ulcerates like the ordinary forms of tubercular lupus; or it begins as an indurated crack or fissure, the edges of which have a tendency to spread. The submaxillary glands tend to become involved; and the disease may eventually prove fatal by the pain, exhaustion, and constitutional irritation thus induced. Lip-epithelioma almost invariably occurs in men—I have never met with a case affecting the lower lip of a woman. It is met with after the middle period of life. Of twenty consecutive cases in which I have operated, and of which I have notes, thirteen were above sixty, and six between fifty and sixty years of age; in one case only did the disease occur under thirty. This disease is at first entirely local, often being induced by some irritation, as by a rugged broken tooth, or by smoking a clay-pipe; and when removed it does not, I believe, very commonly recur. At least, of the very many patients that have been operated upon at the University College Hospital, I have known but few to return with a recurrence of the disease; I cannot, therefore, but come to the conclusion that the operation for epithelioma of the lower lip frequently rids the patient permanently of his disease.

When return does take place, it is not always in the cicatrix or in the adjacent glands. I have seen recurrence at the angle of the mouth and inside the cheek of the side opposite to that on which the primary disease had declared itself and been removed, and this recurrence not till three or four years after the operation.

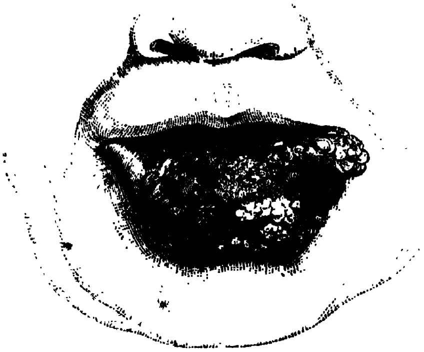


Fig. 552.—Extensive Warty Epithelioma of the Lip.

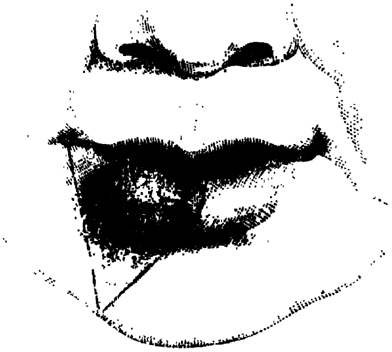


Fig. 553.—Lines of Incision for Removing V-shaped Piece of Lip.

When the glands under the jaw are enlarged in this disease, it is a question whether an operation should be done. In some cases, extirpation of the disease and removal of the enlarged glands (provided that the surrounding soft parts be not involved) may be practised if the patient be in a good state of health; and he will thus be placed in a more favourable condition than before the operation, and will have a better chance of prolongation of life. But in the majority of cases it will be wiser not to operate.

*Operation.*—When once the true nature of the disease has been ascertained, the operation should be performed with as little delay as possible; but before it is done, it is well that any very prominent or broken tooth should be removed, and the tartar cleaned away from the incisors. The operation requires to be somewhat modified, according to the situation and extent of the affection (Fig. 554). If this be tolerably limited, a V-shaped cut, extending widely round it, and carried sufficiently low to include any indurated prolongation of the absorbents, should be practised; the edges of the cut should then be brought together by two hare-lip pins with a twisted suture, as in the case of a simple hare-lip. When the disease occupies a considerable longitudinal extent, but does not dip down very deeply, a slice of the lip should be shaved off, including

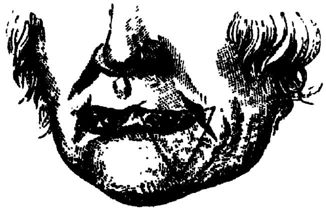


Fig. 554.—Epithelioma of Lower Lip: Lines of Incision.

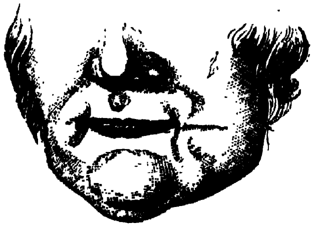


Fig. 555.—Lip after Removal of Epithelioma.

the whole of the morbid structure; and it is often surprising, in these circumstances, to observe how the tissues of the lip will speedily rise to their natural level, thus preventing any material deformity from being left (Fig. 555). In some cases the disease occupies a square surface, and then it is necessary to excise a portion of the lip: when this is done, a considerable gap is left, requiring to be filled by some plastic operation of the kind that will be considered in a subsequent chapter, which may be most conveniently done at the time when the excision is performed. When the disease occurs at the angle of the mouth, it assumes a more intractable character than when affecting the free part of the lip. The same operation—that of free excision—may be applied to it here as in the former case; but with less prospect of success. Should the disease be as extensive as at Fig. 556, the lines of incision must be so planned as completely to surround and to isolate it.

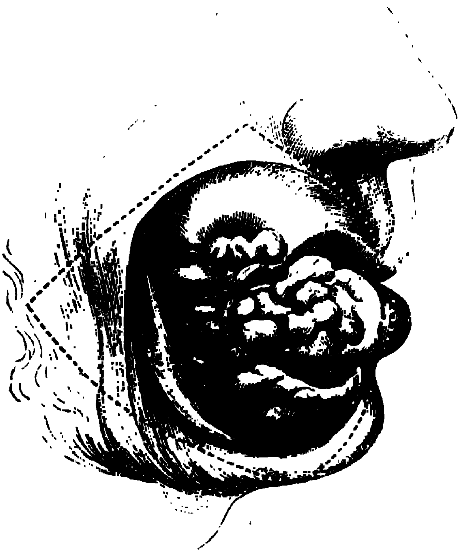


Fig. 556.—Extensive Epithelioma of the Lip: Lines of Incision.

C. Heath has very successfully extended this operation to cases in which the cancer of the lip had invaded the gum, and had involved the lower jaw, by removing a portion of the implicated bone, together with the disease, in the soft parts. Fig. 557 gives a good idea of the cases to which this operation is applicable.

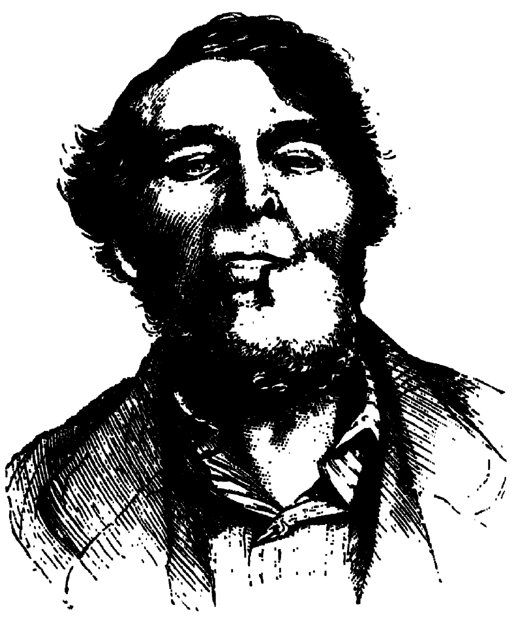


Fig. 557.—Epithelioma of Lower Lip involving Jaw, successfully removed (Heath).

### DISEASES OF THE PAROTID GLAND.

**Parotitis, or Mumps**, is a specific inflammation of the parotid, and sometimes of the other salivary glands. It is common in children, though it not unfrequently occurs in adults. It is highly infectious, and appears to be of a specific character. Both sides of the neck are usually affected, and the swelling, stiffness, and pain are often considerable, though it very rarely happens that suppuration occurs, unless it be in the lymphatic glands of the neighbourhood. Metastasis to the testicle or breast occasionally occurs. Inflammation of the affected organ is the consequence, which in the testis goes on to atrophy. This condition will be more fully described in the chapter on Diseases of the Testis.

The *Treatment* of this affection is simple. If it be severe, the application of hot fomentations and leeches, the administration of salines, and, when the affection is on the decline, frictions with camphorated oil, will hasten its resolution.

**Tumours.**—Tumours of the parotid gland itself are not so frequent as morbid growths situated upon it or in its vicinity; yet occasionally they consist in an actual transformation of its structure. The tumours met with in this region may be simple or malignant. When simple, they are often *encysted;* they are hard, deeply attached, but movable on careful manipulation; round, and of very great size, becoming even as large as a cocoa-nut; the skin covering them is thin but not adherent, and not unfrequently a network of veins covers the mass. These growths frequently send prolongations under the ramus of the lower jaw, and then occupy the whole of the space between its angle and the mastoid process; when firmly bound down, they involve the blood-vessels and nerves in this important region, coming into relation with the styloid process and its muscles, with the internal as well as the external carotid, and even pressing upon the pharynx and projecting into the fauces, as was the case with the patient from whom the annexed cut (Fig. 558) was taken. In such cases as these the deep relations of the tumour are so intricate, important, and extensive, that no operation for its removal can be undertaken, and the patient usually eventually dies in consequence of disturbance of the cerebral circulation, or of compression of the pharynx and larynx. In consequence of the large size that these tumours may attain, they have a tendency to produce atrophy of the parotid, and often, by interfering with the cerebral circulation, occasion various congestive symptoms about the brain. Besides the fibrous, various other tumours, such as *sarcomata, adenomata, enchondromata,* with which *myxoma* is often associated, and *encysted,* occur

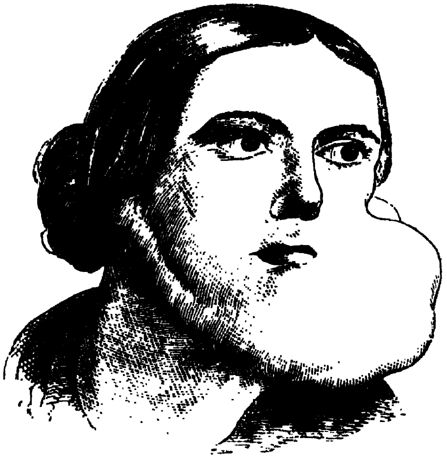


Fig. 558. Fibrous Tumour of Parotid, too deeply seated for Removal.

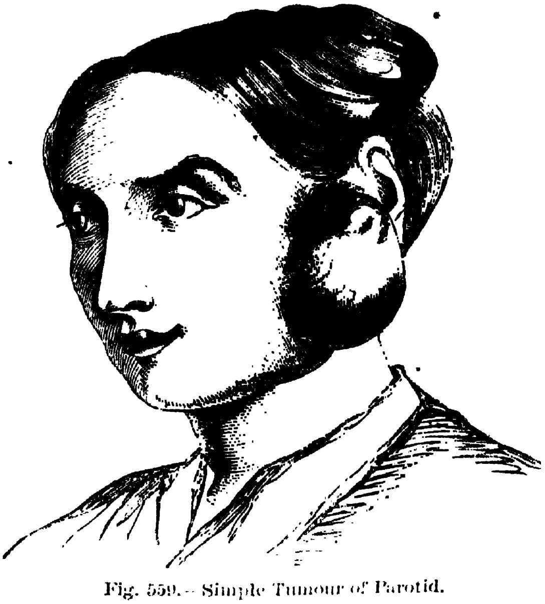


Fig. 559.—Simple Tumour of Parotid.

n the parotid region. These present nothing remarkable in their course here. In some cases the parotid may undergo *cancerous* infiltration, the tumour then presenting the characters and running the course of the ordinary forms of malignant disease.

*Diagnosis.*—It is of great importance to effect the diagnosis between the non-malignant and the malignant varieties of tumours in the parotid region. In the *fibrous*, *sarcomatous*, *fibro-cellular*, and *enchondromatous tumours*, there is always mobility ; and, although the attachments may be deep, the skin is not involved to any extent. The outline of the mass is usually well defined, square, and somewhat lobulated. The progress of the growth is very slow, often occupying many years before it attains any considerable bulk, as in the annexed cuts (Figs. 559, 560), representing a tumour of sixteen years' standing which I excised. In the *scirrhous growth* there is no mobility, but the mass is solidly fixed ; its outline is ill defined, the skin soon assumes a reddish purple colour, is brawny, and presents the usual characters indicative of subjacent malignant action. When these tumours are *encephaloid*, they grow with considerable rapidity, feel soft and pulpy, and are rounded, and ill-defined in their outline, especially under the ear and by the ramus of the jaw.

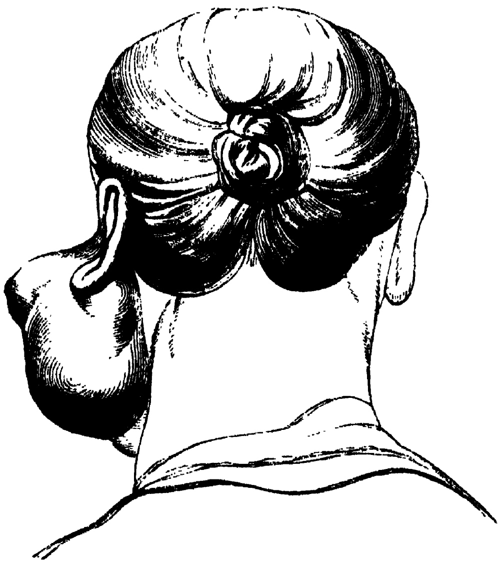


Fig 560.—Simple Tumour of Parotid : Back View.

*Treatment.*—In the treatment of those tumours, extirpation is necessarily the only course that can be adopted; and this should certainly not be attempted if the disease be malignant; for, as it would be impossible to remove its deeper attachments, the growth to a certainty would speedily return. Even if the disease be of a simple character, care must be taken that every lobule and prolongation be extirpated ; for, if any be left, however small, it will without doubt become the nucleus of a new tumour. In removing tumours in this situation, the superficial incisions should be free, and either longitudinal or crucial, so that the whole mass may be fairly exposed. It is not wise to remove integument, however redundant this may appear to be, unless it have undergone infiltration, incorporation with the tumour, or change of structure ; and even then as little as possible should be taken away. The fibrous or aponeurotic investments of the tumour must be fairly opened, and the edge of the knife must then be directed against it, and the dissection carried on from below upwards, or from behind forwards, so that one division of the blood-vessels supplying it may be sufficient. After the tumour has been well loosened by the division of investing fasciæ and structures (and it is surprising how movable it often becomes after this has been done, though it may previously appear to have incorporated somewhat solidly with the subjacent tissues), it should be taken hold of by the hand or a large double hook, and drawn well forwards whilst the deep dissection is being carried on. In prosecuting this, the Surgeon must particularly guard against wounding the temporo-maxillary artery and the portio dura nerve, which are especially exposed to injury. In some cases the division of these, especially of the artery, cannot be avoided, as they are incorporated in the mass that is undergoing removal. The hæmorrhage will then of course be abundant, but may usually be immediately arrested by the ligature of the divided artery; indeed, in most cases the bleeding is profuse, owing to the unavoidable section of nutrient vessels and of large subcutaneous veins, but may generally be readily arrested by ligature and pressure. In most instances, however, by keeping the edge of the knife carefully against the tumour, and by drawing it well forward, so as to loosen it in its areolar bed at each stroke of the scalpel, removal of the morbid mass may be effected without the division of any important vessel or nerve. It is of more consequence to avoid a wound of the portio dura or of the chief branches of the pes anserinus, than even of the temporo-maxillary artery; as persistent and incurable paralysis of the face would result from such an injury. Injury to this nerve is best avoided by dissecting out the tumour by incisions parallel to its main trunk and chief branches, and especially by drawing the mass well forward, and directing the knife towards it. After the extirpation of some small fibrous or encysted tumours in the substance of the parotid, there is often a great tendency to copious secondary hæmorrhage, requiring pressure, or even the application of the actual cautery, for its arrest.

If the tumour, though non-malignant, have been allowed to attain an enormous size, developing at its deeper attachments as well as superficially, with large lobes lying behind and under the ramus of the jaw, in close relation with the pharynx, the internal carotid, and jugular vein, it will not be prudent to attempt its removal.

**Excision of the Parotid Gland** itself is occasionally spoken of, but is very rarely if ever done. I believe that in most, if not all, the cases in which it is stated that complete removal of this gland has been accomplished, tumours overlying and compressing it have been mistaken for it. It is evident that a diseased parotid could not be removed without the division of the external carotid artery and facial nerve.

## TUMOURS OF THE NECK.

**Growths, Simple and Malignant.**—Besides tumours in the parotid region, *Fatty*, *Fibrous*, *Glandular*, and *Encysted Growths* are not unfrequently met with in the *Submaxillary Space*, and in the *Triangles of the Neck*. In these situations they may occasionally attain a considerable size, though they seldom extend very deeply, being superficial to the deep fascia. Hence, when the integuments and superficial structures covering such a growth are divided, it may be insulated with sufficient facility, its fixity being in a great measure due to its being bound down by the investing fascia, rather than to its having contracted deep adhesions. Occasionally, though rarely, a slowly growing tumour develops deeply in the anterior triangle of the neck, lying between the sterno-mastoid, the trachea, and the pharynx, possibly even under the carotid sheath, with the artery pushed on one side, or even running over the anterior convexity of the growth. In such cases, the question of removal requires to be approached with the utmost caution. If the tumour be movable above the vessels, it may generally be taken out ; if it lie below the sheath, even though not fixed to the spine, its extirpation is not practicable. Before determining upon the removal of a tumour situated in one of the triangles of the neck, it is indeed always very necessary that a diagnosis of its nature be effected, and that some opinion be formed of the probable extent of its deep attachments.

The first point to ascertain is whether it be simple or malignant. If simple, it will usually have been many years in growing ; it will be hard but not stony, lobulated or somewhat square-shaped ; the patient's general health being good. It will generally be found to be movable, though not perhaps to any great extent, and will present no sign of incorporation with neighbouring structures ; the fibres of the platysma will not appear to spread over it, and the sterno-mastoid muscle may be traced to one side of or below it. In such circumstances, removal of the tumour may be undertaken by any Surgeon possessing a fair share of anatomical knowledge and manual skill, with every prospect of success. But if the tumour be of stony hardness, have implicated the skin, and be immovable, the whole head being moved on any attempt at drawing it aside, if it be ill-defined under the jaw and ear, or rapidly growing, soft and pulpy to the feel, deeply seated under the angle of the jaw, evidently below the platysma and deep fascia of the neck, and possibly beneath the sterno-mastoid, then no attempt at extirpation should be undertaken, as the mass could either not be removed with safety, or, if it were by any possibility extirpated, the already existing contamination of the neighbouring parts would certainly lead to a speedy recurrence of the disease.

In removing *submaxillary tumours*, a free superficial incision nearly parallel to the margin of the lower jaw, but below this, will usually allow ready extirpation of the mass. In these operations the facial artery is generally sufficiently under cover of the bone to escape injury, but there may be, and usually is, free venous hæmorrhage.

**Hydrocele of the Neck.**—A peculiar cystic tumour, hydrocele of the neck, has been described by Maunoir and Phillips. The disease usually appears in the posterior inferior triangle, forming a rounded tumour, smooth, tense, and elastic, unilocular in some cases, multilocular in others, and filled with a yellow or chocolate-coloured sero-albuminous fluid. It may attain so large a size as to interfere with deglutition and respiration. The largest I have seen was of the size of an orange. The skin covering this tumour is not discoloured, in some cases of natural thickness, in others thin and expanded, so as to give a bladder-like appearance to the growth.

The *Treatment* of this tumour consists in tapping, when complete collapse of the cyst takes place ; which, however, will soon fill again. A permanent cure may be effected by injection with iodine, or by passing a seton across.

**True Hydatid Tumours** will sometimes form in the neck. A woman was under my care at the Hospital for a hydatid tumour of the liver, which I tapped ; seven years afterwards she presented herself with a thin-walled elastic semi-transparent tumour in the posterior inferior triangle of the neck, about the size of an orange. This I tapped, and found it to contain clear serous fluid, with the remains of echinococci. In another case, that of a lad aged about 18, otherwise healthy, I removed a hydatid tumour as large as a shaddock from the nape of the neck, where it was deeply seated under the trapezius, growing apparently from the substance of the complexus or splenius capitis muscles, and lying close upon the cervical spine and the occipital bone.

**Enlargement of the Lymphatic Glands** of the neck, terminating either in chronic induration or in abscess, is of such common occurrence as to constitute perhaps the most frequent form of glandular enlargement. The tumours thus formed present nothing peculiar in their progress or treatment when occurring in this situation ; except that when abscess forms it should be opened early by a small incision, and in such a direction, corresponding to the natural folds of the skin, as to leave as little scarring as possible.

## BRONCHOCELE.

The thyroid gland is subject to various simple chronic enlargements, which commonly go by the name of **Bronchocele**, or **Goitre.** These may be divided into four distinct forms.

1. **Simple Hypertrophy.**—The thyroid gland may be simply hypertrophied, and may then attain a very considerable size; in some cases forming an immense lobulated tumour on the forepart of the neck, such as is met with in various districts of this country and of the continent, more especially in the valleys of the Alps, in which the disease is and has been endemic for ages.* In the majority of instances, however, in England, the tumour is of but very moderate size, commencing at first as a mere fulness and uniform or rounded enlargement of the isthmus, or of one of the lateral lobes of the thyroid gland, and gradually increasing, until perhaps, by the pressure of the growth confined between the sterno-mastoid muscle and the deep structures of the neck, the voice becomes croaking and harsh, and respiration and deglutition seriously affected. It is seldom that the bronchocele distorts the structures of the neck to one side ; but this may happen. Thus I have seen the larynx and trachea pushed completely over to the left, forming a long convexity in that direction, whilst the carotid sheath on the right side was thrust behind the sterno-mastoid muscle.

There is a remarkable connection between tumours of the thyroid gland of this kind, and a general anæmic condition of the system. In London nothing is more common than to find a certain degree of bronchocele in pale and bloodless women and girls ; indeed, so frequent is the coincidence that it is impossible not to regard it in the light of cause and effect. Great prominence of the eyeballs is frequently associated with these conditions. In practice we constantly observe this triple clinical combination, viz., anæmia, exophthalmos, and bronchocele ; and the connection of these has been commented on by Graves, Basedow, Sichel, White Cooper, Aran, Begbie, and numerous other practitioners. The anæmia here is the link between the bronchocele and the exophthalmos. In cases of bronchocele uncomplicated with anæmia, the protrusion of the eyeballs is not met with. Thence, as anæmia is more common in women than in men, the exophthalmic bronchocele is most frequent amongst females.

2. **Cystic Bronchocele** is due to the development of cystic tumours in

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* Quis tumidum Guttur miratur in Alpibus?

the thyroid gland, either associated with, or occurring independently of, general hypertrophy of it. These cysts may be single or multiple. When single or of large size, as in Fig. 561, they usually contain clear serous fluid. When multiple, they are filled with a fluid that presents the ordinary characters of altered blood, being dark, grumous, or like coffee-grounds, and have often cauliflower-like excrescences projecting into their interior. They appear to be of the nature of hæmatomata, and occur independently of anaemia in persons otherwise perfectly healthy, and more commonly in young women.

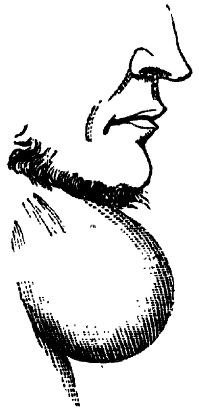
Fig. 561. — Cyst of Thyroid, containing clear Serous Fluid.

3. **Pulsating Bronchocele** is occasionally met with. The pulsation, which is excentric and distensile, is synchronous with the heart's action, and evidently due to the vascular character of the tumour itself. This form of bronchocele is sometimes conjoined with the cystic. When it is confined to one lobe only, care must be taken not to confound the beatings with those of carotid aneurism; a mistake which I have known to occur. The diagnosis of the two affections has been adverted to at p. 89, Vol. II.

The Causes of bronchocele have been much discussed, both professionally and popularly. The most generally received belief is, that the disease is directly occasioned by some impurity in, or peculiarity of, the water that the patients drink; and it has been supposed that water coming through chalk or limestone is particularly apt to occasion bronchocele in this country, and that water resulting from melted snow is its occasioning cause in Switzerland. But these ideas are groundless. Hard water is drunk largely in this country in districts where no bronchocele occurs, and snow-water is never used in Switzerland; spring-water, and that of the purest kind, being the only kind that is drunk. It would appear that air and locality have much more to do with the occurrence of bronchocele than water. In mountainous countries the disease occurs almost entirely amongst the inhabitants of valleys, where the air is moist and stagnant; the inhabitants, especially, of valleys that run north and south, into which the sun does not penetrate readily, or for many hours in the day, which are always in the shade of neighbouring and overhanging mountains, are especially prone to it. This is well known to be the case in Switzerland, where the disease is endemic; so also in large towns, it chiefly occurs amongst the poor who live in cellars and kitchens, or damp, ill-ventilated streets and courts. When it is met with in the richer classes, it is mainly found amongst children and young people shut up in school-rooms or devoted to a sedentary and indoor life, unnatural and prejudicial. It is rarely, if ever, met with amongst those who lead open-air and active lives. Bad food and low living no doubt conduce to it. The tendency is probably hereditary in some cases; when associated with idiocy, constituting that wretched condition "cretinism," it undoubtedly is so. Every race of men is liable to bronchocele, and it occurs in all latitudes, from the Arctic region to the tropics. Thus Franklin found bronchocele amongst the inhabitants of the polar regions, and Mungo Park amongst those of the interior of Africa. In this country it is most common amongst women.

TREATMENT.—The treatment of bronchocele must vary according to the size and character of the tumour, and the constitutional condition associated with it. When small, and associated with anæmia, and of comparatively recent formation, it is best treated by improving the general condition of the patient. This may be done in various ways: by the administration of good food; by change of air from a low and damp to an elevated and dry and healthy situation. The change to a higher, and drier, and more airy locality has been much insisted on by those who have studied the disease in those valleys of Switzerland in which it is endemic; and establishments have been erected several thousand feet above the level of the sea, on mountain-tops, with the view of curing patients thus affected. Guggenbühl has been particularly successful in these endeavours. In towns, the patient, if living on the basement floor, should be moved to the upper storey, if possible, and should be encouraged in habits of outdoor rather than of sedentary or indoor occupations. Besides these hygienic measures, which are of the first importance, the disease may be treated medically by the administration of iron internally, especially the iodide, with the external application of iodine or of iodide of lead ointment. Indeed, in the soft bronchocele occurring in anæmic exophthalmic females, iron is of the utmost service, and acts almost as a specific.

In bronchoceles of large size, hard, and unconnected with anæmia, the chief reliance is to be placed on the free and continuous use of *iodine* internally as well as externally. The iodide of potassium is the best form in which to give the iodine internally. The quantity of this medicine should be gradually increased, until from 20 to 30 grains are given three times a day, either alone, in milk, or in combination with some preparation of iron. The iodide is probably the best. But iron is very necessary in all the anæmic and exophthalmic forms of the disease. Iodide of lead and compound iodine ointment may be used with advantage. It has been recommended by Mouat that the biniodide of mercury ointment (16 grs. to the ounce) should be well rubbed in for several days; and then, the tumour being covered with it, the patient should be exposed to the strong heat of a mid-day summer sun. This method of treatment, which is said to have been extremely successful in India, has not been tried in this country to a sufficient extent to enable an opinion to be formed of its merits. In some instances *pressure* has been of use, especially in conjunction with the iodine inunctions; though it is not so easy to apply this means, and any considerable degree of it can necessarily not be borne, on account of the increased difficulty of respiration that is thus occasioned. In fact, the compression exercised upon the tumour by the sterno-mastoid muscle in some of these cases is occasionally so considerable that it becomes necessary to divide its tendon subcutaneously, in order to relieve the trachea from the constriction to which it is subjected. When the tumour is chiefly cystic, the fluid contents may be drawn off by tapping, and an endeavour may be made to cause the cysts to close by inducing inflammation in them by the injection of tincture of iodine. When bronchocele is very large, and very chronic, its absorption cannot, I think, be expected to take place by these or any other means; and the question then arises as to the propriety of having recourse to operative interference. The introduction of a *seton* across the tumour is occasionally attended by beneficial results. This operation, however, is not unaccompanied by danger; a patient in the neighbourhood of London, on whom it was being performed some years ago, lost his life by the puncture of a vein at the root of the neck, into which air was spontaneously admitted. **Injection of perchloride of iron** by means of the syringe figured at p. 935, Vol. I., is likely to be of service in some cases of very vascular and pulsating bronchocele; but it is not without the special danger of forming a plug in the circulation, and rapidly fatal embolism has followed its use. In one instance of pulsating bronchocele in which I employed it, although much local inflammation and deep-seated suppuration were induced by it, the patient was in the end materially benefited.

**Ligature of the Thyroid Arteries** has been practised by some Surgeons, with, it is stated, a certain degree of success. The difficulties and danger of the operation, the uncertainty of its results, and the readiness with which the arterial supply would be forwarded to the tumour from other sources, have caused it to be but little resorted to by Surgeons of the present day. In one case of pulsating bronchocele in which I had recourse to this treatment, no benefit resulted from it.

**Excision of the Tumour** is seldom to be thought of; the disease, even though of large size, not being usually detrimental to life, and the danger of the operation itself extreme. The vascularity of the tumour is so great, and the arterial supply that it receives from both sets of thyroid arteries so abundant, that any attempt at extirpation must generally be attended by such profuse hæmorrhage as necessarily to endanger the patient's life, and perhaps to prevent the completion of the operation. Cases have, it is true, occurred to Roux, Warren, Greene, and others, in which large bronchoceles have been successfully extirpated; but these operations must be looked upon as altogether the exception in the treatment of the disease; and instances are certainly not often met with, in which a Surgeon would think it proper to undertake so serious a procedure for an affection that is not necessarily mortal. Cases, however, occasionally occur in which, from pressure on the trachea, œsophagus, and jugular vein, the dyspnœa is so excessive, the dysphagia and vertigo so serious, that there is no escape from death except by the removal of the tumour. In such cases I have more than once been tempted to remove large pendulous pedunculated bronchoceles, but close examination has satisfied me in all such cases that the pedicle of the tumour was so vascular, containing large arterial and venous branches, and so intimately connected with the sheath of the carotid, stretching under the sterno-mastoid, which was expanded over it, that no operation could be safely undertaken. But cases have occurred in which operation has been successfully practised; and of all the methods for the removal of enlarged thyroid gland, P. H. Watson's operation is probably the safest in execution, and most satisfactory in results. It is done as follows. A free linear incision is made in the mesial line from the upper to the lower end of the tumour, the fascia being as freely opened as the skin; but the delicate fascial investment of the thyroid gland, which is a prolongation of the sheath of the thyroidal vessels, should be left intact. The vessels on each side of the tumour, superior and inferior thyroidal, are then to be securely ligatured within their sheath, by passing an aneurism-needle through this, and tying them *en masse*. It is of the first importance that the vessels be tied in and with their sheathing envelope; for, as Watson truly observes, if this be not done, they will be found to be so fragile as to risk being cut through by the ligatures. After the ligature of the four sets of supplying vessels, the cellular capsule of the thyroid should be opened by being scratched through in the mesial line, and the mass removed with care and delicacy, all attachments being divided by blunt-pointed scissors. The principal danger, besides the hæmorrhage, would probably consist in the adhesion of the tumour to the sheath of the vessels, more particularly the internal jugular vein. In one case referred to by W. Greene, this vessel was wounded.

4. **Acute Bronchocele** is a very different disease from the last. It is of rare occurrence, but has been met with both sporadically and epidemically. In this form of the affection the thyroid gland undergoes rapid enlargement, attaining to the size of the fist or larger in the course of a few days or weeks. Both lobes and the isthmus become affected. Owing to the rapid enlargement of the thyroid body, the fascia of the neck covering it does not expand with sufficient rapidity; and the consequence is that the subjacent parts, as the trachea and recurrent laryngeal nerves, become compressed, so that respiration is seriously impeded, intense dyspnœa sets in, and death from asphyxia may result in the course of a few weeks. It is difficult in these cases to know how to save the patient; for tracheotomy is impracticable, owing to the manner in which the tumour dips down behind the sternum. In such cases, tapping the tumour in different places, and the division of the fascia of the neck covering it, would give relief, and afford time for the action of remedies.

# CHAPTER LVI.

## OPHTHALMIC SURGERY.

[This Chapter has been written and contributed by J. F. STREATFEILD, F.R.C.S., Surgeon to the Royal London Ophthalmic Hospital, Moorfields, and Ophthalmic Surgeon to University College Hospital.]

### OPERATIONS ON THE EYE.

OPERATIONS on the eye are in many ways peculiar. They specially demand an accurate knowledge of the anatomy of the parts concerned, of their relative connection and position. In eye-operations, any small error in estimating the relationships of the delicate parts constituting the organ of vision is much more likely to be injurious than in operations on other parts of the body. Again, as the eyeball is enclosed in dense firm membranes, capable of little or no extension, inflammation is fraught with very much danger to the future integrity of the parts. An external opening made into the globe in all probability soon heals; but the parts within, if there be inflammation, are perhaps in so much the greater danger; and, as the circumference of the globe is limited, the inflammation is so much the more and more continually aggravated. The re-absorption of inflammatory effusion, and the return to the healthy state, are hindered by the unaccommodating nature of the sclerotic and cornea. The optic nerve will give way, after some time has elapsed, in any case of intraocular pressure, with, of course, serious injury to vision (see Glaucoma, p. 438). The sclerotic or cornea may allow extension; and a corneal or sclerotic staphyloma, when these structures have been weakened and deteriorated, is formed, but very slowly, and the bulging is a permanent deformity almost always very seriously interfering with good vision. Inflammation of the eye, as of other parts—such as the testis—which are enclosed in inextensible fibrous coverings, is attended with pain in proportion to the unyielding nature of the envelope; but the functions of the eye are more readily destroyed, and we cannot in the same way relieve tension by strapping or by simple incision, nor can we so well apply cold externally. If one eye be destroyed by internal inflammation, especially of a traumatic nature, whether accidental or surgical, the other will not improbably follow it and also become blind by a peculiar "sympathetic inflammation," to which the eye, among duplicate organs, is specially liable. In some cases this is almost certain; so that the Surgeon has then further a clear duty to perform. Inflammatory effusion or suppuration within other organs, is followed generally by much less destructive results as regards the integrity of the whole; in them, abscess probably soon finds a harmless outlet. A few ophthalmic operations, especially on the parts around the eye, resemble operations in similar cases in ordinary surgery, and are done according to general rules given in other chapters (see Chapter LVIII.).

It used to be always remarked of the diseases of the eye that, even of many of the internal changes, iritic, cataractous, &c., it was no small advantage that we could *see* their progress, and that their study was instructive inasmuch as it was the more certain. With the ophthalmoscope our advantages are tenfold increased, and we may *see* morbid processes existing even in the choroid or sclerotic coats, in the retina and optic nerve. Amaurosis is an almost obsolete term, or is, as before, at any rate restricted to those (now comparatively few) cases of blindness in which we cannot *see* any morbid change—to nerve- or brain-diseases more or less affecting vision, and of which, even with the ophthalmoscope, we can find no evidence. But the ophthalmoscope has not added much to our powers of *surgical* treatment of eye-diseases. With its aid, detached retina has been evacuated and foreign bodies or cysticercus removed from the vitreous chamber. With it, also, we can often make a previous examination to find if there be any *deep-seated* disease to mar the good result otherwise to be expected of operation. If we include in the term ophthalmoscopic examination the lateral focal illumination of an eye by a convex lens and artificial light, our prognosis is of course by this often very much assisted in any proposed surgical interference, as it is in the diagnosis of many of the diseases, but only of those whose progress could be less perfectly seen and watched years ago, before the ophthalmoscope was invented and the lens used in this way,—the iritic, cataractous, and other cases of disease, not very deep-seated, above mentioned. This concentrated side light, or oblique illumination, has been used in some operations within the eye, such as those for the removal of foreign bodies in the iris or anterior chamber, at the time of the operation, as well as for the diagnosis and prognosis generally of these and other cases.

**Performance of Operations on the Eye.**—Nothing by way of gaining experience in eye-operations is of much account, except actually operating on the patients themselves. Short of this, it is most valuable to watch carefully the operations of others. In eye-surgery, practising operations on the dead subject is of little or no good to the beginner. When, in general surgery, a limb is to be removed, it is amputated at a distance from the seat of the disease ; or, if an artery is to be tied, it is secured at a place remote from the aneurism, so that such operations may well be practised on the dead subject. But, in eye-surgery, we can never operate at a distance from the disease ; either we are immediately concerned in the part that is diseased or we are close upon it, as in removing an opaque lens, or in performing iridectomy on an adherent iris. Squint operations (tenotomy), extirpation of the eyeball, tapping the cornea, slitting the canaliculus, and some of the first steps of the more important eye-operations, such as the making a section of the cornea, may be practised on the dead subject ; but, as to all the rest, it is mere waste of time.

Almost all operations on the eye are done with the patient lying on a hard couch, not quite so high as an ordinary surgical operating table, with a hard pillow to raise the head of the patient a little, and comfortably. The foot of the couch is in a window, facing the north if possible, and giving a good light. The Surgeon stands behind the head of the patient, so as to use both hands conveniently, and to be out of the way of the light. A towel spread on the pillow is thrown from behind forwards over the patient's head, as far as his forehead, and this, at the temples, may be held, if necessary, on each side, by the hands of an assistant. In some cases the wrists of the Surgeon may be brought, on each side, up against the temples, to steady the patient's head when he is passive under chloroform. In eye-surgery, the arms are seldom required to be moved whilst actually operating. In these minute operations often the fingers only, seldom more than the hands as well, are necessarily changed from their first position. Perhaps some pronation and supination of the fore-arms may be called for; but, the patient being under the influence of chloroform, his head even then may be steadied or rotated or moved from side to side, as may be best, by resting the wrists against the temples of the patient. Even the ordinary internal squint-operation may be done from behind the head of the patient; but, in this case, the Surgeon is in a better position when he is sitting on the edge of the couch, on the side opposite to that of the eye about to be operated on, so that he may be as little as possible in his own light. In either position, whether from behind or on one side facing the patient, he will, for one or the other eye, if both should require to be operated on, have to cross his hands, if not so ambidextrous that he can use the scissors with his left hand. And, in this particular operation, that the Surgeon is in an unfavourable position as regards light is of little importance to him. In using the spring-wire stop speculum to keep open the lids, it is a point worth remembering that, chloroform not being used, less pain will have to be borne by the patient, if, when the speculum has been allowed to open to the widest extent, it be then a very little closed and then so much fixed open. In many very trifling operations a speculum is often used, when chloroform is quite unnecessary, and when the instrumen would not be wanted at all by a practised operator, who prefers his fingers. The same remark often applies to the use of forceps, for fixing the eye (see Tapping the Cornea, p. 431). It is well if the fingers can be made to answer the purposes of speculum and forceps; but such pressure on the globe of the eye with the fingers as is required, when they are employed not only to keep the eye open, but to fix the globe, would be dangerous in any case in which any considerable opening is to be made in the coats of the eye, as in some of the cataract operations, iridectomy, &c. Operations on the eyelids and conjunctiva, the skin, and mucous membrane, are probably very much more painful than are any of the internal operations on the eye: therefore an anæsthetic may be used in such cases for the sake of the patient. In the major (internal) operations on the eye we must use the anæsthetic very much for the advantage of the operator; to whom any little movements of the patient, during an operation, are a great inconvenience, if they be not actually dangerous to the result.

In testing the amount of vision of a cataractous or otherwise blind eye (so called) we must cover the other. So also, to produce perfect seclusion of an eye, whether after operation or not, we must cover both; because the two eyes, their irides, and the muscles of the globe, act together. And whenever a shade is ordered, it should be over both eyes. Of eye-bandages, the best, unless much pressure be required, is Liebreich's, which consists of an oblong piece of knitted cotton with a piece of tape sewn to it at one end, and at the other two such tapes, which are joined, and have beyond them another single tape. The two tapes are put one above and the other below the occiput to steady the bandage, and the two single ends of tape are tied together, as tightly as may be required, round the head. If common bandages be employed, the two ends may be tied in a knot on the side of the head opposite to that of the eye affected; or, the two ends being split for a short distance, the two lower half ends may be tied above the occipital protuberance and the two upper ones below it. The object is to employ no more length of bandage than may be required, and to prevent the bandage from becoming shifted. A narrow flannel bandage, long enough to be passed many times round the head, is the best bandage when pressure on an eye is required.

## OPERATIONS ON THE EYELIDS.

We are here only concerned in those operations which are, at least to some extent, peculiar to the eyelids.

**Tumours.**—Of tumours there are here, as elsewhere, many kinds.

**Molluscum** is very common about the skin of the eyelids. This is best treated by thrusting a sharp-pointed knife through the tumour, with the back of the knife towards the base, and cutting outwards so as to divide the upper half of the growth. Then with the ends of the two thumb-nails, one on each side, pressed together below the base of the tumour, the whole is turned out easily at once.

A **Sebaceous Tumour**, often containing hairs, is of frequent occurrence, especially at the upper and outer margin of the orbit. It should be dissected out altogether. It is generally very difficult or impossible to remove the whole without opening or bursting the sac.

The common **Tarsal Tumour**, as it is called, probably has its origin in disease of the Meibomian glands. If left some months, it may become as large as half a pea; and then it suppurates, and at last bursts on the conjunctival side of the lid. It should be opened as soon as, when the inner surface of the lid is exposed, the situation of the tumour is shown by a greyish semi-transparent spot. Of course, if it have suppurated, it should be opened. By two punctures a crucial incision is made in the more transparent part of the tumour, and the whole soft contents are squeezed out with two fingers. The contents are probably firm, and cannot be evacuated, if the semi-transparent spot do not appear.

**Ptosis.**—The muscle that should raise the upper lid is sometimes permanently paralysed, and then it may be noticed that the occipito-frontalis muscle of the same side, in endeavouring to raise the lid, has corrugated the skin of the brow, on the side of the paralysed muscle. Hence, in order to make more use of this new action of the occipito-frontalis, an operation is sometimes employed when all else has failed. It consists in the removal of a horizontally oval piece of skin and some subcutaneous parts *of the upper part* of the upper lid, of a sufficient size to allow the upper lid to cover the globe, and yet, when the patient lifts his brows, that the cornea may be readily uncovered. A fold of the skin is seized with forceps at the place from which it is to be taken; and if it seem to raise the lid enough, and not too much, it is cut away with scissors to just that extent, and an oval wound is left. The loose and vascular skin of the lids will very soon heal without the application of sutures.

**Tinea Ciliaris** is very common, but only among the very poor. Great cleanliness is required. The eyelashes should be kept cut as short as possible, for the better application of any ointment or lotion that may be prescribed, and for the more effectual removal by bathing of any accumulations of discharge from the edges of the lids. In *chronic* cases these dried accumulations should be at once removed by bathing and wiping, or with forceps, and, the lashes being cut close with scissors, the excoriated parts beneath lightly touched, at intervals of a week, with the solid nitrate of silver. The edges of the lids should be kept greasy always, meanwhile, with the citrine or some other ointment.

**Trichiasis.**—*Trichiasis* is an ingrowing of some of the lashes, as distinguished from *Entropion*, which is an inturning of the whole lid. In both, the lashes are in contact with the globe of the eye; but in entropion the lid may be temporarily rectified and held in proper position, and the lashes are not then turned in; whereas in trichiasis the eye cannot be freed from the lashes that are in contact with it without the lid being drawn away, apart from the globe of the eye, as it is abnormally in *Ectropion.*

*Causes.*—Of the causes of trichiasis the commonest is, perhaps, the treatment of "granular" lids by solid caustics applied too exclusively to the lining membrane of the lid just within the margin, whereas any local applications of the kind should be, at least equally, applied far back. (In these cases entropion and trichiasis are often combined—see "Entropion.") Vascular nebula and pannus may then very probably result from the irritation; first, of the granular conjunctiva, and, secondly, of the superinduced trichiasis. It is, perhaps, because granular conjunctiva chiefly affects the upper lid, that trichiasis most often occurs in it, and so, of course, pannus appears first at the upper part of the cornea. As to the so-called *Distichiasis,* the disease has no real existence; there are no cases in which two rows of lashes exist separately.

Cases of trichiasis vary so much, and the modes of operating are necessarily so various, that only a few of the operations can be here detailed, and a few practical facts noted. The practice of pulling out the ingrowing eyelashes is worse than useless; because they only grow again, the hair-bulbs being left. The case is therefore only temporarily relieved, and, in the end, vascular nebula of the cornea and consequent blindness are produced by the constant mechanical irritation of the inverted eyelashes. Lashes should only be pulled out as a temporary expedient. Patients sometimes come to the hospitals, almost blind, who have been taught by Surgeons to practise the pulling out of their ingrowing lashes; they have done it for years, they have their own tweezers and looking-glass for the purpose, they are relieved each time *temporarily,* but, far from being cured, are always by little and little becoming worse. Again, they not unfrequently break off the lash, and then the broken end causes more irritation and pain than the whole lash had done before. An eyelash, when it is to be pulled out, should be properly seized, near the skin, with broad and rough-ended forceps, and very steadily drawn in the direction in which it grows. But a patient will twitch it out quickly with his tweezers at right angles to the direction of the growth of the lash, and so it is very liable to be broken off.

If only one or two lashes grow in they may be pulled out, once or twice, in the hope they will not grow again, nor again be so misdirected. But if many lashes grow in, or if a few only be always growing in, they must either be excised with their hair-bulbs, or an attempt must be made, by producing cicatrisation, to give a right direction to their future growth. The latter operation, being more tedious and less certain in its results, is not worth performing, except on young persons or those to whom personal appearance is important. When the hair and hair-bulbs are extirpated, the whole row of lashes of each lid operated on should generally be removed, though some only here and there be inverted, unless those which are turned in be all at one part of the margin of the lid. In such a case, a small round piece of the skin and all the structures down to the cartilage may be excised, *close to the edge of the lid*, so as to expose the roots of the inverted lashes, and the lashes drawn outwards with many fine sutures, inserted wherever they seem to be most required ; after which the scar may effectually evert the ingrown lashes. If the whole row of lashes, or, perhaps, even if some all along the edge of the lid, be growing in, a similar operation to that last described, but extending the whole length of the margin of the lid, may be done. If this should fail, the lashes may afterwards be wholly extirpated. The excision of a part of the row of hair-bulbs is very often unsatisfactory, because the subsequent cicatrisation at the extremities of the wound will often draw in and invert some of the nearest lashes of those rightly directed.

**Excision of Hair-bulbs** is thus done. A forceps (*compressorium*), having for its lower blade a slightly curved plate of metal, has this blade placed under the lid, between it and the globe. The other blade, the skin of the lid being drawn away from its margin, is then brought down upon the outer surface, and is screwed down, so as to steady the eyelid between the two blades and hold it just firmly enough to control the bleeding, which in any operation on the eyelids is liable to be considerable and troublesome. This upper blade, to admit of operating, unlike the lower one, is but a skeleton, leaving all the centre of the lid and its margin, on the outer side, exposed (Fig. 562). With a scalpel, two incisions are made along the margin of the lid, one on each side of the row of eyelashes, carefully including all of them ; the knife, for both incisions, being held in the direction of the growth of the lashes and made to cut deeply. The ends of the incision are curved into each other, and then the piece of skin, &c., including the lashes, is detached altogether with scalpel and forceps.

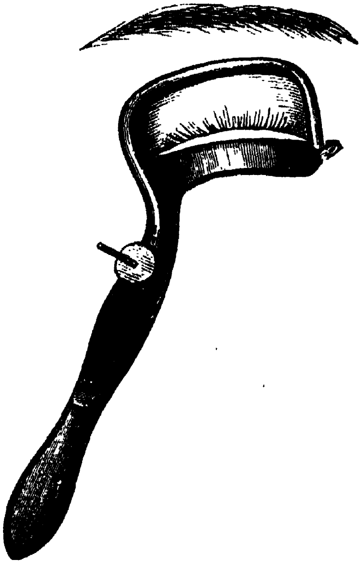

Fig. 562.—Forceps applied for Excision of Hair-bulbs.

The inner of the two horizontal incisions is the important one. It must be made, with a firm hand, within every ingrowing eyelash, but in a regular curve, so as not to make an irregular edge to the lid. This incision often carries away with it a longitudinal strip of the cartilage, which gives shape to the lid. It should not trench on the conjunctiva or on that aspect of the lid. Then, if any of the bulbs have been cut through and are left, they should be removed: they are easily seen in the wound as little dark points. No sutures are necessary; the skin of the lid is abundant.

**Symblepharon, etc.**—When the palpebral and ocular conjunctivæ or the margins of the lids have become united, the bands may be divided, and, to hinder their reuniting, their cut surfaces may be touched with nitrate of silver, oiled lint interposed, and a probe passed along the track of the wound occasionally. But, unless a probe can be, in any such case, in the first instance passed freely under the bands, so that they may be isolated, they will probably reunite to such an extent, that the operation will have been almost useless. A better plan, perhaps, than dividing the band when the union is inconsiderable, is to tie a strong ligature, passed beneath such a band, around it, and then let it drop out in the course of time. If a probe cannot be passed under and around the adherent surfaces, or union of the edges of the lids, it may be first of all advisable to pass a few silk threads, to be secured and left for some weeks, so as to make a fistulous track which shall be the limit to which it is intended to free the lid, when the parts united are afterwards cut through.

**Entropion.**—If, in a lax state of the lids, as when a patient has lately become thin, anything should excite the action of the orbicularis muscle, those fibres next the edge of the lid not unfrequently cause it to become rolled inwards; and then the irritation of the lashes against the ocular conjunctiva tends always to aggravate this state of the parts, set up, accidentally as it were, in the first instance, by some other irritation. This abnormal condition is most commonly seen in the lids of old people, and especially in the lower lid, which is kept out less than is the upper lid, by the convexity of the globe of the eye. For instance, it is a not unfrequent occurrence, and must be looked out for, and at once remedied if it occur, after the operation for senile cataract. The lids of old people contain but little fat, the skin lies in many folds, and after an operation, the skin of the lid is bathed in tears, and so the more easily becomes inverted; very often, too, water-dressings are applied. Some slight irritation or pain produces—voluntarily or involuntarily—an extra contraction of the orbicularis, and the edge of the lid is tilted inwards. Though the irritation of the lashes is, in these cases, very much less than might be expected, and is not at all comparable to that arising from trichiasis or entropion in younger persons, in whom the lashes are stiffer or grow irregularly, the orbicularis is stronger and the lid altogether firmer, it must be closely looked for and prevented. The patient should be taught, when the inversion occurs, to put his finger on the skin of the lid, and so pull it down and replace the inverted edge of the lower lid and the lashes. Water-dressings must be avoided. Very probably, however, this will not be sufficient; and then, the skin of the lower lid being drawn down and well dried, some collodion should be painted along the edge of the lid with a large brush, and the parts kept still until it is dried. If this be insufficient to remedy the abnormal condition, the following operation, applicable also to many cases otherwise originating, in which the skin of the lid is abundant, should be done. An oval piece of the skin of the lid, *quite close to the margin*, must be excised horizontally. As much as is sufficient of the skin and subcutaneous tissues is seized with toothed forceps, raised a little, and cut away with scissors curved on the flat. The lid is drawn open a little and steadied by the finger of an assistant, or by the little finger of the left hand of the operator, which holds also the forceps. Then all those fibres of the orbicularis nearest to the edge of the lid are snipped away with the scissors, so that the cartilage is quite exposed. No sutures are required, as a very speedy union of the edges of the wound is not desirable, and a broader, firmer cicatrix is obtained by a slower process of healing. Enough of the skin should be removed, and all the inner fibres of the muscle causing the inversion.

More difficult, because more complicated cases, of older date and yet of common occurrence, are those in which the lid, its cartilage, &c., is altogether thickened, generally as a result of the application of caustics in the solid form to the palpebral conjunctiva for a longer time than was needed, probably for granular lids, or, as usual, too near to the margin only of the lid. The upper lid is the one most frequently affected. This is the commonest cause of trichiasis; but it may result in entropion, or in both together. The trichiasis must be treated by excision of the hair-bulbs, or otherwise, as may be required. The entropion may be remedied in this, and in such cases of thickening of the lid, by "grooving" the outer surface of the length of the cartilage, near its margin, by first exposing it, and then making two longitudinal vertical incisions into the cartilage two-thirds or more through its thickness, inclined to each other, so that they meet below and form a V-shaped groove along the edge of the lid. Then, if there be no wrong direction in the growth of any of the lashes (trichiasis), but only the regular row is carried in with the inverted lid against the eye, a few fine sutures are introduced through the skin of the edge of the wound, next the margin of the lid, and then through the edge of the groove in the cartilage, farthest from the lid's margin. If the lashes have been removed for concomitant trichiasis, the fine sutures are merely put through the two lips of the skin-wound, so as to approximate the sides of the groove in the cartilage, and keep out the incurved margin. In some cases of entropion, an operation, the reverse of that sometimes adopted in cases of ectropion, the V-Y-operation, may be done. A Y-shaped incision may be made through the skin and subcutaneous parts of the (lower) lid, and the point of the angle, being dissected up, is extended down below the point from which it was taken, and then secured with some fine sutures.

**Ectropion.**—For this morbid condition, and, in a less degree, for entropion, it is not possible to point out any single operation as a cure. Neither of them is a disease, but the result of various diseases; and even though two cases of ectropion, for instance, may be considered due to the same disease, they will very probably call for different methods of treatment. Some operations in these cases are often, however, applicable in a general way, as the disease which has been their origin is common to them. In thin old people, who have been stout, a weak orbicularis muscle, with loose skin, induces passively, on any slight provocation, ectropion of the lower lid, and perhaps also consequently lacrymation (which always aggravates the eversion of the lid—see "Slitting the Punctum," below). The very existence also of the ectropion in time only aggravates the disease by exposure, and consequent thickening, of the conjunctiva. A tendency to entropion or ectropion may often be remedied by means which in a normal lid would produce the contrary results. Thus caustics too freely applied to the conjunctival surface of the margin of the lid, it has been said, have often caused entropion. So, also, if sufficiently used, the application of nitrate of silver, or some other caustic from time to time, will sometimes cure a slight ectropion. It has been said that a weak orbicularis induces a passive ectropion ; and also that a removal of some too powerful and active fibres of the same muscle, next the lid's margin, will cure many trifling cases of entropion. Severer cases of old and confirmed ectropion will probably require to be treated by a V-shaped excision of a part of the whole thickness of the lid : the cut surfaces being afterwards brought together, and adapted with entomological pins and silk twisted around them. Ectropion generally occurs in the lower lid ; entropion (in the numerous cases in which there is thickening and perhaps trichiasis) generally in the upper lid, being there artificially produced. Ectropion from deficient power, or paralysis, of the orbicularis, by force of gravity, and entropion from excessive action of the marginal fibres of the same muscle, as explained already, both affect the lower lid as a rule.

## OPERATIONS ON THE TEAR-PASSAGES.

**Slitting the Punctum and Canaliculus.**—In any case in which, without any special exciting cause, the tears are found to run down the cheeks, this state of things must be remedied as soon as possible, or it aggravates itself. In the first place, in operating here, we have to ascertain, first, if the lower punctum be rightly placed in contact with the globe of the eye ; second, if it be patent ; thirdly, if the canaliculus or nasal duct be obstructed. Seldom, if the punctum be averted from the globe, will it be enough to restore its right position. Whilst disused, it has become permanently too narrow. If it be everted a little, it will be enough that the punctum be divided, so that the tears may reach the slit-shaped artificial opening. If it be closed, or too small, it must be slit up ; and if the canaliculus or nasal duct be obstructed, it must be thenceforth repeatedly probed.

Among the preliminary "special exciting causes" of an overflow of tears, besides grief and casual external stimulants, such as peat-smoke, we must not omit to search for eyelashes, or other foreign bodies, in or upon the conjunctiva. If there be intolerance of light, there is generally an equal amount of lacrymation when the eyes are exposed to light. Both are excessive in the common conjunctivitis of weakly children. Probably, even though the cause of the weeping be but temporary—swelling of the parts near the orifice during conjunctivitis, or abscess of the margin of the lid everting the punctum—it will be best to slit the inferior canaliculus. And as to the slitting operation, it may quite safely be done in any case, even if only temporarily, required ; for, if it do no good afterwards, it does no harm, and the imperfection of the punctum seems to be of no more serious importance than is that of the pupillary aperture after an iridectomy that was needed and then done. As the lower lid is of the two the most subject to ectropion, so also it seems that the lower punctum is the more frequently everted, obstructed, or obliterated. Gravity is perhaps concerned in both. The Surgeon's attention is seldom called to the upper punctum ; if it be too small, altogether absent, or abnormally placed, perhaps he is not called on to discover the fact ; but, on examination, the punctum is generally found to be in right position and patent, and yet insufficient to prevent lacrymation when the lower punctum, to which the tears gravitate, is not fit to receive them, or the canaliculus and nasal duct to convey them away. If the lower punctum be so much everted that for any length of time it is dried, it probably becomes narrowed, and would not carry away the tears, even if the ectropion were remedied and the punctum again moistened.

*Operation.*—The patient is seated in a chair, in a good light, with his head thrown back, a towel over it, and resting on the chest of the operator, who is standing behind him. A finger or the thumb of the left hand is placed lightly on the lower and outer part of the skin of the lower lid, which is drawn forcibly down and outwards, and fixed by pressure on the malar bone sufficiently to overcome the force of the orbicularis. If the punctum be not everted, so that it may be fairly seen, it is well exposed to view by slight traction with another finger on the skin of the inner part of the lower lid, drawing it downwards a little and fixing it in that position. If the skin of the lower lid be wet with tears or greasy with ointment, it should be first of all wiped dry ; or a corner of the towel may be required to be applied between the fingers and the eyelid. The knife employed is very narrow, and about an inch in length altogether. It ends in a small probe, of about a line in length, with a slightly bulbous extremity, bent somewhat towards the cutting edge (Fig. 563, *b*). It is held with the probe-point turned downwards and directed into the punctum ; and, when the Surgeon is sure of its being in the right position, some little force may be employed, if necessary, for its passage through the punctum. If the punctum be quite obstructed or disguised, it is well to be as sure as possible that the knife is rightly directed ; if little pits be made in the soft skin or conjunctiva with the probe-end, it is so much the more difficult afterwards to make sure of the real position of the punctum. A minute depression, made oval by traction on the skin of the lid, will be detected in the right anatomical position of the punctum, even if it be quite impervious to the tears. The right position may be judged of by relaxing for an instant the dragging force, and, if the lid be bathed in tears, it may be wiped dry, and a very little quantity of the tears may be detected lying in the natural pit or oozing from it. The probe-point being within the punctum, the knife is turned half-round, so that the cutting edge is directed upwards and towards the nose, and the probe-end, which is not in a line with the rest of the instrument, is directed in that which, anatomically, is known to be the direction of the canaliculus. This is then slit up, as far as the probe end will let the knife go, towards the nose, or, at least, well into that part of the palpebral conjunctiva in which the tears

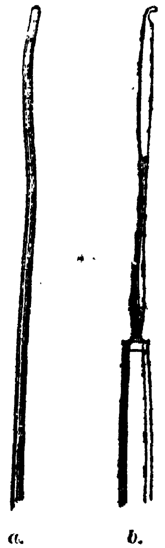

Fig. 563. — *a.* Bowman's Probe (No. 6) for Nasal Duct. *b.* Weber's Knife for Slitting Canaliculus.

habitually lie. The nasal duct may now be probed if necessary. If a little clot of blood lie between the edges of the wound, it is no disadvantage, as it will hinder their reunion. A day or two after the operation, a probe should be passed along forcibly between the edges of the wound to tear through recent adhesions, if they have formed. After this, the open channel will be patent; perhaps not throughout the extent of the incision, but sufficiently far from the punctum to gain all the advantages to be desired of the operation, whether for the admission of tears to the sac and nasal duct, when they are in a healthy state, or for the entry now and then of a probe to be passed along the latter channel if it be obstructed. A small piece of the inner lip of the slit-up canaliculus has been sometimes removed with advantage, when there is eversion of the edge of the lid of an amount and kind which would suggest it. It is easily done, the lid being fixed and drawn down and outwards, with forceps and scissors.

The upper punctum seems to be alone generally insufficient. I do not remember to have slit it up usefully but once, in a case (*Ophthalmic Hospital Reports*, vol. iii. p. 4) in which the lower orifice could not in any way be found in the dried mucous membrane. The upper punctum was in no way abnormal, and, when slit, I passed a curved probe by it into the sac and back by the lower canaliculus so as to make it emerge at the lower punctum. Then the lower punctum could be slit as usual, and the case was cured forthwith. The upper punctum and canaliculus, even if slit, unfortunately do not make a convenient way for the probing of the nasal duct, because of the projection of the brow; and the upper channel alone, even if rightly placed and patent, does not prevent lacrymation, or at least very often fails.

In *acute inflammation or abscess of the lacrymal sac*, the lower canaliculus must be slit, and the matter, if any, thereby let out on the conjunctival aspect of the lid, or evacuated with gentle pressure steadily made with two or three of the fingers over the sac. A new difficulty in this case presents itself in the firm swelling of the soft parts of the neighbourhood of the sac, which makes it very difficult to obtain a view of the punctum so as to introduce the probe-ended knife. This may generally, however, be done by pressing the point of a finger or the end of the handle of a scalpel into the œdematous tissues just outside the right position of the punctum, so as to evert it, although the whole lid cannot be everted or drawn aside. An abscess of the lacrymal sac, if neglected, will open through the skin, and leave a permanent scar, but in no case should it be opened externally, unless an external opening should be plainly inevitable, and even then the slitting the canaliculus and probing the nasal duct must be done as before. A *fistula lacrymalis* is understood to mean a permanent external opening, leading down to the lacrymal sac, not to the gland. It is not an uncommon result of neglect of obstruction of the nasal duct. Inflammation of the sac arises, and goes on to suppuration; and, this being neglected, the abscess opens externally through the skin. The pain being relieved, the disease is probably still neglected, and a fistulous opening is established. A scar cannot then be avoided; but a fistula in this situation may generally be induced to heal, if the nasal duct be diligently probed and the natural outlet of the tears re-established. Whilst there is discharge, it may be well, by the use of a small India-rubber bottle syringe introduced by the fistulous opening, if it have not begun to contract, or by the slit-up canaliculus, to inject tepid water or astringent lotions from time to time.

**Probing the Nasal Duct.**—The normal punctum admits only so very small a probe, that, when the nasal duct is in any way obstructed, it must be slit up as described. Thenceforward a sufficiently large probe can be passed, when it is required, to act as a bougie to overcome such slight obstructions as not unfrequently are the cause of the enduring lacrymation, or, it may be, of the subsequent serious inflammation and suppuration within the lacrymal sac; to evacuate the muco-purulent matter, and then afterwards to obviate the obstruction by slow degrees. Bowman's probes are of six sizes. Fig. 563 *a*, represents the largest, No. 6, of the actual size. It is the most useful size, and, although very often it cannot at once be passed through the nasal duct, we always aim at so doing in the further treatment by probing of any such case. Lacrymal probes (for the nasal duct) have two slight bends at perhaps one-third and two-thirds of an inch from the end, the one bend being made at a quarter turn from the direction in which the other bend is made. By having these different bends, the end of one of these probes will so much the better find its way and pass along the nasal duct, either unassisted, held loosely in the fingers, or being slightly rotated by the Surgeon as it is pressed downwards. The patient being seated with the back of his head against the chest of the Surgeon, who is standing behind him, the probe is held horizontally in the right hand for the right eye, and *vice versâ*; with one finger of the other hand the skin of the lower lid is drawn down and outwards, as in the operation of slitting the canaliculus. With another finger, the skin of the same lid is drawn down a little just at the punctum, so as thus to evert the lid and show the orifice by which the probe is entered, the point of it being kept down a little, so as to feel the bottom of the open mucous channel as it is passed along; and, the parts being stretched at the same time, it is hardly possible to make a false passage. The probe is known to be in the sac by the resistance that is felt, and by the absence of any elasticity; and, when the lower lid is no longer kept on the stretch, pressing the end of the probe inwards towards the nose, if the probe be in the sac, does not pucker the skin of the parts concerned. If the probe have met with any obstruction in the canaliculus, if it have folded the lining membrane and cannot therefore pass, it should be withdrawn a little and then passed onwards again, the lower lid being always drawn very much down and outwards, so as to make sure that it is in the right direction; then, by steady pressure, with slight rotation of the probe, the obstruction may be soon overcome; if not, a smaller and a smaller probe must be used until one is passed. Then the size of the probe is noted, and each succeeding time a larger one is attempted to be passed. It may be well, perhaps, to leave it in a short time when it is passed through a stricture.

The probe, having been introduced into the lacrymal sac, has yet to be passed along the nasal duct. To do this it is very necessary to proceed in no uncertain way, or many difficulties may yet be encountered, and a false passage made. The point of the probe, now in the sac, is against the bony inner wall. It must be held there whilst the probe is brought up from the horizontal to the vertical position. It will then, at least, begin to pass along the nasal duct, if it will not traverse the canal. The direction of the nasal duct—downwards, backwards, and inwards—being borne in mind, the probe is gently pressed on ; it must not be held so tightly between the fingers that it cannot follow the course of the duct, and sometimes, it has been observed, a slight rotation by the Surgeon's fingers will facilitate matters. If it will not pass down to the floor of the nostril, perhaps an inch and a half, a little more pressure may be exerted and continued, and increased if the probe seem to pass at all. The probe generally passes easily enough through the lower part of its course. Experience alone can determine when and how much pressure may be exerted without fear of making a false passage.

For stricture in the bony nasal duct, it would seem to be useless to leave the probe in for a short time, as may be done for the strictures of the canaliculus above described. It should be removed when it has passed all along the duct. It must be passed again many times at intervals of a few days, and the size, up to No. 6, increased, if at first it have not been possible to pass the largest probe. If, after the obstruction has been remedied, as very often happens, the stoppage again take place (the punctum and canaliculus are now always patent), recourse must be again had to the probing. The smaller-sized probes are liable to be caught in folds of the mucous membrane and to make false passages ; and No. 6 (or 5 or 4) by a little pressure in the right direction, and with all due precautions, will almost certainly pass. If the probing finally will not cure the obstruction, a style, introduced by the slit canaliculus, must be worn for a time. It consists of a silver wire, of the size of the No. 6 probe, two inches or less in length, and abruptly tapered into half an inch of about the size of the No. 2 or 3 probe ; this end is bent down when the style has been introduced.

### SQUINT-OPERATIONS.

In these operations the object is, by dividing the tendon of the rectus muscle which produces the Strabismus, to cause it to become attached to the globe of the eye at a point behind its natural insertion into the sclerotic. Then the muscle regains and retains the power of moving the eye, but in a diminished degree, so as, usually and without any special exertion, to place the eye in a position parallel to that of the other. The first point in diagnosing a fit case for tenotomy in squint cases is to ascertain that all the muscles of the eye act, and that there is no paralysis of any of them. Then, again, an operation should not be performed in any case in which the squint is not confirmed, where sometimes there is no degree of squint ; in such a case, spectacles should be tried. Convex glasses (for hypermetropia) are very often needed in squint cases to remedy a slight degree, or, at least after the operation, to correct the pre-existing error of refraction. The hypermetropia is the cause why most of the patients who squint have begun to do so at the age at which children have learned to read and observe near objects closely. Very young children are therefore very rarely subjects for squint-operation. And even if the case be one of a confirmed squint, the operation (in a very young child) may be deferred, *if the vision of neither eye be impaired.* A large majority of these cases are of convergent strabismus, requiring division of the internal rectus tendon or tendons. Of 307 primary operations for squint, at the Royal London Ophthalmic Hospital, in Moorfields, in 1871, 275 were for convergent and 32 for divergent strabismus. The superior or inferior rectus tendons are very rarely divided. A squint *downwards* is hardly ever seen but in hydrocephalus, of which it is supposed by some to be pathognomonic; it is, in these cases, of both eyes, and only occurs *at intervals.*

To ascertain the existence or the degree of squint, the patient is placed standing before the Surgeon, who observes which eye seems to squint. The Surgeon, if, for instance, the patient's right eye be turned inwards in looking at him, extends and closes the fingers of his right hand, bringing them with the back of the hand to the face of the patient, close up before his left eye, without touching it; then, the patient still regarding the face of the Surgeon, the left eye being shut out, the right eye is everted from its former position and turned out sufficiently to continue the steady gaze of the patient in the face of the Surgeon. The Surgeon now removes his hand quickly from before the left eye, and this is observed to be turned inwards, as the right was; probably it now quickly adjusts itself, and, as at first, the right is again inverted. Or the Surgeon, if the right eye do not now seem to be again turned in, uses his other hand, and excludes, without closing, the patient's right eye, to see, as the patient is always looking steadily in his face, if the other will now seem to correct itself; and so he proceeds, successively and alternately, to confirm his diagnosis. It is very improbable that, if there be some degree of convergent strabismus, even though not constant but recurrent, it will not be manifested when the patient is under the excitement of a formal examination, and is regarding a rather near object, the face of the Surgeon. If there be no squint and the previous diagnosis were in error, whichever eye is shut out in the way described, the other will not move or change its position, for it continues to look at that at which it was desired to look.

If we desire to estimate exactly the *degree* of strabismus, the patient is desired to look straight before him at any object. A little mark is then made on the skin near the edge of the lower lid of the wrongly directed eye, at a point vertically corresponding with the outer (or inner) edge of the circumference of the cornea. Then the other eye of the patient is closed with the hand; and the patient, without turning his head, is desired still to regard the same object. The squinting eye is then righted; and another mark, again corresponding to the same part of the margin of the cornea, is made on the lower lid. Then the distance between the two marks is measured, and the squint is said to be of so many lines. If, in a case of convergent squint, the interval be of as much as three or four lines, it is probably advisable that the tendons of both the internal rectus muscles should be divided at once, rather than that alone of the eye only ostensibly squinting. In the more common and less degrees of convergent squint, it is best at first in each case to divide only the internal rectus tendon of the eye habitually inverted, and to divide the other afterwards only if the first operation should prove to be insufficient. To determine which eye is to be operated on, close attention to the patient, for a short time, covering neither eye, will generally be enough; or both eyes of the patient may be repeatedly covered for a minute and uncovered with the hand of the Surgeon, so as better to observe which eye is habitually turned in. As to repeated divisions of the same internal rectus tendon, when the eye has persistently remained inverted, experience is rather unfavourable; but if without it the defect be not remedied, it must be done, supposing, of course, that the opposite internal rectus tendon has been cut.

**Operation.**—The operation for squint is thus done. A wire-speculum (Fig. 564, *a*) is inserted between the lids, which are thus widely opened. A small fold of the conjunctiva is then seized with toothed forceps with fine points (Fig. 564, *b*), just below and a little in front of the insertion of the rectus tendon to be divided; with straight and rather blunt-pointed scissors (Fig. 564, *c*), this little fold is cut through horizontally; the forceps is then inserted, closed, rather deeply in the wound, and a fold of subconjunctival tissue, fascia, &c., is pinched up close to the sclerotic, and divided with the scissors on its sclerotic side. Now, the forceps still holding that which was last taken up with it, the points of the scissors being still pressed against the sclerotic, and each time very little opened, a succession of little snips is made, the scissors being pushed backwards to some little distance beyond the insertion of the rectus tendon and below the muscle. When none of the fascia in this tunnel-like opening remains uncut, when it offers no more resistance, the scissors are withdrawn, and, remembering the direction of the deep little opening just made, and observing that the eye has not changed its position, or, if it have moved, allowing so much for the change of position, the strabismus-hook (Fig. 564, *d*) is quickly inserted and carried directly backwards through the length of the opening in the conjunctiva and subconjunctival tissues, and then, *the point being always kept close against the convex sclerotic*, the handle is depressed, and the hook passed upwards under the tendon of the muscle to be divided, and brought forwards up to its insertion. The points of the scissors are then carried along the sclerotic side of the hook, and opened a little, so that one blade passes with the hook under the tendon, and the other in front of it. This blade will pass beneath the conjunctiva without penetrating it, or if it be too closely adherent, the two blades of the scissors, closed, may, before dividing the tendon, be made to open a way in front of the insertion of the tendon. The tendon is then cut

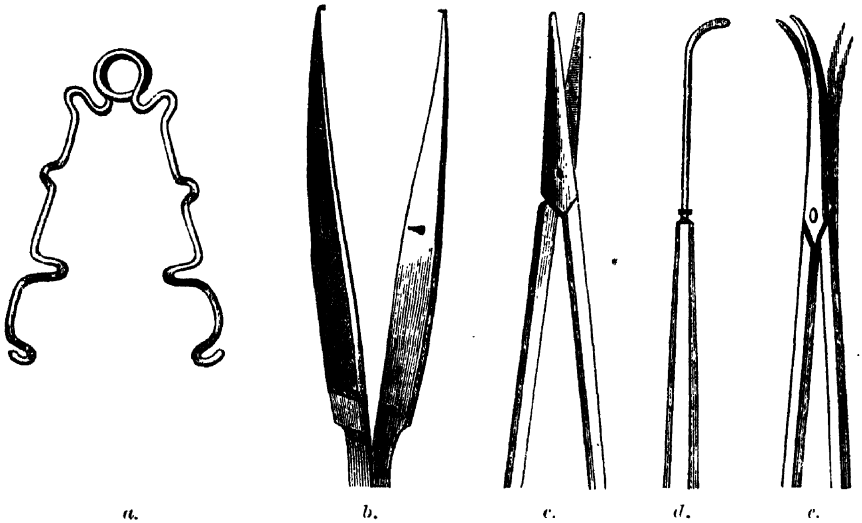

Fig. 564.—*a.* Wire-Speculum. *b.* Toothed Forceps with Fine Points. *c.* Straight Scissors. *d.* Strabismus-Hook. *e.* Scissors for Dividing Optic Nerve in Extirpation of the Eye.

through; the hook being at the same time everted a little to allow one blade of the scissors to pass between it and the sclerotic. The scissors' blades are opened as little as may be required, so as to prevent any unnecessary disturbance of the parts, or tearing open of the external opening. An inexperienced operator is likely to be misled by a want of knowledge of the feel of the sclerotic, when it is reached as the hook is passed along beside the globe upon it; or by a fear of keeping close to the globe of the eye. There is no fear, especially for an anatomist, of cutting into the sclerotic. The tendon, before it is lost in the sclerotic, lies for some, or all, the distance along the surface of this membrane; so that, to insert a hook beneath it, the end of it must be brought to bear at a point inferior to and behind the insertion; and then, being steadily pressed against the sclerotic with some little force, it must be carried upwards and backwards and then a little forwards. In these operations for the division of tendons we must also recollect how wide is the insertion, and at what distance from the margin of the cornea; and in this they vary a little. The opening in the conjunctiva should be made no larger than will be enough. The conjunctiva, when the tenotomy is completed by this method, prevents the eye from being carried unrestrainedly in the opposite direction. The object is not merely to divide the tendon; but, according to the degree of distortion, the operator will separate, more or less, the tendon and muscle from its surroundings. In an extreme case, any minor tendinous insertions lying beneath the chief portion of the muscle concerned must be searched for and divided; while, in trifling cases, these, or at any rate the areolar tissue in connection with the tendon, should be undisturbed. It is not advisable, however, in extreme cases, that the operation should be made to resemble the old squint-operation, by dividing the conjunctiva over the insertion of the tendon. If this be done in internal strabismus, it leads to retraction of the caruncle and the plica semilunaris, and a staring look of the eye, although it be made to act in a parallel direction with the other. To obviate the difficulty of an extensive *accidental* rent of the conjunctiva during the operation, especially if it seem to be thin and liable to be torn open, the forceps, instead of a second time being made to grasp the parts to be divided, may at first be made to seize the subconjunctival tissues together with the conjunctiva in a fold in a radiating direction from the centre of the cornea, and the conjunctival opening made far back from the margin of the cornea; the scissors also should be less blunt-pointed than those figured, and by pressing their separated points towards the eyeball firmly before closing them, to make the division, the operation may be completed without using the forceps in the wound at all. In extreme cases, the corresponding tendon of the opposite eye certainly should be divided. The test of complete tenotomy in these cases is that, when the hook has been passed so that if any fibres were uncut they would be caught in it, the concavity of the instrument can be brought up to the convex edge of the cornea under the conjunctiva, and will remain there passively, without any dragging force.

As squint-operation is a painful one, at any rate as compared with most eye operations, it is usual to give an anæsthetic; but, during and after the inhalation, the muscles of the eyes do not act together as they would without its having been used, and, at any rate, at such times the patient cannot be made to attend well to the Surgeon's wishes in directing his eyes. Children with or without chloroform or bichloride of methylene will not give us this assistance, and they therefore at least should always have the anæsthetic.

The operation being over, and it being found that the tenotomy has been satisfactorily done, a piece of lint wetted with cold water, and a round hollow sponge or some wool dipped in the same, are at once tied tightly over the eye, with a strip of common bandage fastened behind the opposite ear in a knot. In six hours the lint, sponge, and bandage may be left off (the fear of "black eye," or much ecchymosis, being past), the two eyes may be uncovered and brought into use together (for distant objects as much as possible), and the eyes only bathed with lukewarm water as often as the patient may desire it.

Tenotomy, as concerns the muscles of the eyes, is hardly ever done but for the cure of one or other of the kinds of squint actually existing. It is, however, desirable to divide the external rectus tendon in some cases of muscular asthenopia (insufficiency of the internal rectus muscles) as well as of external strabismus; and several of the tendons (sometimes in the same eye of the same patient) have been divided in cases of oscillating globes; and the upper, inner, and outer tendons have been cut when an artificial pupil has been made necessarily at the upper margin of the cornea, so as to weaken the opponents of the inferior rectus.

### OPERATIONS ON THE EXTERIOR OF THE GLOBE.

**Pterygium.**—This is not a common disease in England. The cases which we have seen have been in adult men, sailors, perhaps foreigners. The disease consists in an hypertrophy of some portion of the ocular conjunctiva and subconjunctival tissues, consequent upon some long previous chronic irritation or inflammation; and as the vessels of this mucous membrane pass to or from the centre of the globe in front, radiating in all directions, it has a triangular shape, of which one angle is at or approaches to the centre of the cornea, just as much as the vessels of a chronic ulcer of the cornea following phlyctenular ophthalmia, which follows one of the exanthemata, have a wide circumferential origin, and are definitely bounded on each side, ending as it were at one point or apex—the ulcer itself. So it is in what has been called "fascicular keratitis," though the vessels are not collected in a bundle in it, but converged.

Pterygium is to be got rid of, because it will always steadily advance up to the centre of the cornea, and so, to some extent, interfere with vision; and very much too, if, as is not uncommon in these cases, more than one pterygium should form in the same eye, and, advancing from different directions in the circumference, meet in the centre, towards which the apex of the growth is always directed; or if, as is not common, a pterygium should advance from below upwards. The growth is also to be removed, because it is a conspicuous deformity, easily remediable, so that at least only an irregular whitish scar is left in its place. A pterygium should be removed in any stage of its growth. At first, it is but little redder than the surrounding conjunctiva, and hardly at all raised above the conjunctival surface. It has then been called a "membranous pterygium." Afterwards it becomes very much more vascular and raised above the surface—"fleshy pterygium." In either case an operation is called for. No other treatment is of any use.

Pterygium has been removed by dissecting up the growth from apex to base, transplanting the apex of the flap thus formed into an incision made along the lower part of the ocular conjunctiva beneath the lower lid, and fixing it with sutures in this position. I do not remember that in any of the cases in which I operated in this way the disease returned; but excision of the whole growth more effectually removes the deformity than merely transplanting it; and total abscission is the commonly adopted practice nowadays. Nevertheless, even when carefully removed, pterygium is apt to return; and hence it is important in operating to remove the whole thickness of it, down to the sclerotic and cornea.

*Operation.*—An incision is made with a scalpel through the conjunctiva, along the borders of the growth, whilst put on the stretch by the eye being drawn with forceps in the opposite direction, if necessary by an assistant; and then with a pair of forceps, with rather long sharp teeth, the whole width of the pterygium is taken up, between the two lines of incision in the conjunctiva, at about the middle of its length, and raised sufficiently to allow the scalpel to be thrust beneath it with the edge towards the cornea. The growth being well raised from the surface of the globe, and the traction made in the direction opposite to the place of the pterygium being relaxed, the scalpel is carried onwards, close to the surface of the cornea, up to the centre or as far forwards as the growth extends. The whole is shaved off at once; the flap is then seized and raised, and dissected off the surface of the sclerotic, and finally removed altogether as far back as it seems to extend at its base, near the junction of the ocular and palpebral conjunctivæ. If any small portions of the pterygium have been left, they should be seized and shaved off the surface of the cornea or sclerotic. The growth should be removed quite up to its margins and to its apex, as far forwards on the cornea as it extends. It may everywhere be raised with forceps from the firm structures, cornea and sclerotic, beneath. If a fine shaving of sclerotic or cornea be taken off, it is not of the serious importance that has been suggested; but of course it should not be done. All soft parts, where the pterygium is situated, should be dissected off the sclerotic and cornea; and if the knife be held flat to the surface of the globe of the eye, there is no fear that an incision will be made actually into the globe.

After the operation no special treatment is required; but, by using warm water to bathe the eye, great cleanliness is maintained; and, if the movements of the eyes cause any pain in the eye operated on, they may be tied up, and so kept at perfect rest for a while.

**Removal of Foreign Bodies external to the Eye.**—A foreign body, such as a particle of dust or of coke, superficially sticking in the eye, is generally to be found embedded in the cornea. The cornea is the most prominent part of the eye; and if a foreign body should hit the sclerotic conjunctiva, it is probably somewhat obliquely, and so it may glance off at once and not remain there. It is probably soon dislodged from the sclerotic conjunctiva, as it is loose and easily moved, and is washed away in the tears. It is often very difficult to see the very small foreign bodies which lodge in or upon the cornea, especially if the iris be dark-coloured, as they are also generally. In order to detect the presence of a foreign body, the Surgeon must open widely the patient's eye in a good light, and bid him look in various directions or on all sides, successively; when, if the iris be light-coloured, the foreign body is probably soon detected as a dark speck, and may be removed forthwith. If the foreign body be light-coloured or transparent, its situation may be detected on the eye itself by viewing the convex mucous surface, in all its parts successively, with the light of the window reflected from it, and then, at this point in particular, the light is irregularly reflected as it is in case of a simple abrasion, or loss of substance, when there is no foreign body. If it be not thus detected, the lower lid must be pulled down with a finger placed on the skin of the lid, and the patient desired to look very much upwards, so as to expose completely the palpebral and ocular conjunctival surface of the lower part of the eye. It is, however, more probable that, if the foreign body be under either eyelid, it is the upper one. In this case the Surgeon, standing before the patient, places the end of his forefinger sideways on the lid near its outer edge, without involving any folds of loose skin; and pressing a little on the eye, makes the lid slide downwards, as far as possible, over the lower lid. The lid (not the lashes) is then seized firmly by the end of the thumb applied sideways; and the end of the forefinger is turned downwards, while the lid is held firmly by the thumb and finger. The lid is thus everted (Fig. 565). This is a better plan than using a probe, or a pen laid horizontally on the lid, and then pulling the lid by the lashes over the barrier so as to evert it. The fingers are always available, and the patient is not so much afraid of them as of any instrument. The little operation cannot, however, be done the first time it is attempted. The patient may move back his head just as the turn is to be completed (therefore the head of the patient must be steadied by being placed against the wall, or the back of his chair, or by the other hand behind it); or the lid is not secured between the finger and thumb before the eversion is attempted; or the lashes only and not the lid are held; or one fears to press the forefinger sufficiently into the eye to effect the eversion. It is very much more difficult if the patient be fat, the eye deeply set, and the orbicularis strong, or the lid thickened and contracted—inclined to be inverted—by old results of ophthalmia. The upper lid being everted, it is held so and pushed upwards as much as possible with the thumb against its edge; and, the patient being desired to look very much down, we expose nearly the whole of the upper palpebral and ocular conjunctivæ. If the foreign body be not now seen, it is well to pass the tip of the forefinger lightly over the everted palpebral conjunctiva, as in this way the foreign body may perhaps, if transparent, be felt; or we may pass the spoon-end of a common probe quite up to the sulcus, if it cannot be seen, and along between the upper palpebral and ocular conjunctivæ, to catch the foreign body if it should be

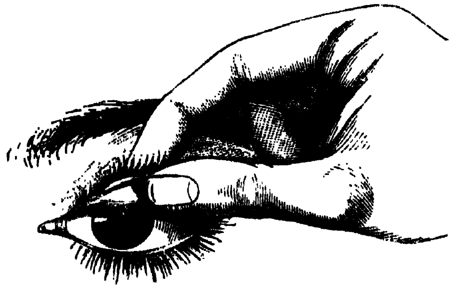

Fig. 565.—Eversion of Upper Lid for Detection of Foreign Bodies.

there. If it be not now found we may again examine the cornea, for it is here that nearly all foreign bodies in the eye are found ; and the oblique illumination with the ophthalmoscope, using a second convex lens as a magnifier, may be serviceable in this examination. Not unfrequently a larger foreign body, such as a small button, or a husk of corn, purposely or accidentally introduced under the upper lid, has passed beyond the upper edge of the cartilage, and so is retained for months or years, until the persistent slight irritation leads to its detection and removal. Therefore, in doubtful cases, as above recommended, the spoon-end of a probe should be used.

To avoid error in diagnosis, it is always well to inquire if the patient remember the time at which the foreign body entered the eye, when he has the sensation of an existing body, for there are many irregularities of the surface of the palpebral conjunctiva, which, in its movements, give the sensation as of a foreign body when there is none. Conjunctivitis especially is a cause ; and if there be no such cause, and the patient recollect no particular time at which he first felt the foreign body, and "something got into his eye," we must look for some little tumour, or a somewhat inverted eyelash or other persistent cause. A patient may have the sensation as of a foreign body in the eye when it is there no longer, but has left, perhaps, a slight abrasion.

A foreign body in the cornea is best removed with the end of a little instrument which is like a piece of wire flattened at the end, and with a round edge, but little sharpened, like a "spud." A piece of wire, beaten out at the end, is the instrument made for themselves, and used by some one of their number, by the workmen in some of the large factories. With this, the lids and the eye itself being held open and fixed with the fingers, the foreign body is turned out of the hollow in which it is embedded. Sometimes, if it be very deep in the cornea, a sharp-pointed or cutting instrument must be used.

There is a class of cases by no means common, which may be considered together with foreign bodies in or upon the cornea, for the offending substance is quite superficial to the cornea and keeps up irritation. It appears as a perfectly opaque, dense, whitish opacity on the front of the cornea, unlike leucoma in its *perfectly definite* outline, and in being very superficial and *dead-white* in appearance. There is also some injection of the eye, which there is not generally in cases of circumscribed leucoma—the dense corneal opacity left long after the inflammation before it. The foreign substance is deposited in some hollow of the cornea, an excoriation, abrasion, or ulcer, probably after using some lotion of acetate of lead, which is too often applied by patients for all eye-inflammations indiscriminately. It must be picked out of the little hollow, like any other foreign body ; and if it be in a layer beneath the epithelium, this must be scraped off, and then the deposit will be found immediately beneath it ; and in these cases, with some difficulty, little by little, in broken flakes or fragments, it can be removed with the point of a knife, or, with the edge of it held flat, it may be shaved off. It should be, at all events, altogether removed ; for, if it should be succeeded by a dense leucoma, the latter is of no importance beyond the fact of the opacity of the cornea ; whereas the former is somewhat equivalent to a foreign body also. But it will not probably be followed by a leucoma; the cornea will become and remain tolerably or quite clear when this superficial opacity is removed from its surface. A little olive oil is dropped upon the cornea, and the eye bandaged with belladonna lotion or fomentation, until the wound has healed and the epithelium is restored.

**Tapping the Cornea.**—This little operation often does much good, in cases generally only medically treated, locally and generally. When there is pus between the layers of the cornea (*onyx*) or in the anterior chamber (*hypopyon*), or in *painful* ulcer of the cornea without suppuration, it often acts like a charm; some of the aqueous humour and pus is evacuated, the pain disappears, and the chronic ulceration of the cornea begins to heal kindly. The operation should be adopted in a greater number of cases; but it must be done properly without wounding the lens or iris, or doing anything but just to make a small clean puncture obliquely into the aqueous chamber, and so letting the fluid contents leak away quietly, and not very rapidly. In onyx and hypopyon, the tapping, to be efficacious, may require to be repeated at short intervals; and if it fail, as it will probably, if it do not from the first seem to have been beneficial, iridectomy must be done, and will probably succeed. Iridectomy is often performed at once in these diseases; but, in most of the less serious cases, with no increase of tension of the eye, the minor operation of tapping is all-sufficient.

*Operation.*—A spring (stop) speculum to keep open the lids, and a fine-ended and two-toothed forceps to steady the eye and hold it down, may be and are generally employed (Fig. 564, *a* and *b*). But, unless pressure on the globe would endanger the good result, they are unnecessary, and are liable to alarm the patient. In performing the operation, the upper lid should be raised, and the end of the forefinger of the left hand laid horizontally and rather flat upon the edge of the lid and on the globe above the cornea, taking care here, as in other eye-operations, not to touch the eye with the finger-nail. The *lower* lid is similarly depressed and held down with the middle finger of the same hand, on the eyeball below the cornea. The two fingers are separated as widely as necessary, and such pressure is exerted upon the globe backwards as will allow no opportunity of closing the lids and of the orbicularis regaining its power of action (Fig. 566). The front of the globe is now very prominent, and the eye is at least as much under control as if it were held with forceps. With an ordinary broad needle, flat forwards, held in the right hand, the puncture is made in the cornea near the margin, the point being soon directed obliquely downwards and across the anterior chamber, as if about to make a counter-puncture at one-third of the circumference. As the eye tends to roll upwards, the needle, when directed downwards, cannot wound

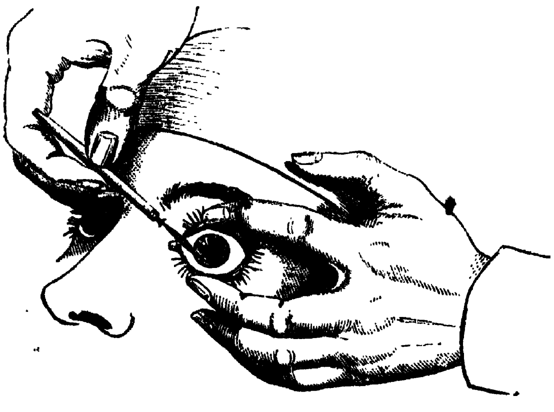

Fig. 566.—Tapping the Cornea.

the lens. In this way the blade never passes the pupillary margin; its point is always in front of the iris, never of the lens (Fig. 566). As soon as the broadest part of the blade has entered the cornea, it is partly withdrawn, and, cutting downwards a little meanwhile, the point of the needle is again directed to the centre of the anterior chamber. As the opening is now a little larger than the blade, this can be rotated a little; and, when it is held in this way, the aqueous humour or the contents of the aqueous chamber will flow out beside it, more or less slowly, according to the amount of the rotation. As it is almost all evacuated, the pressure of the two fingers, keeping open and steadying the eye, must be a little remitted; probably no great effort at movement will be made by the patient at this time, but, to prevent possibility of accidents, the broad needle, still held flat forwards, should now be brought altogether somewhat forwards, and may thus be used in some degree as a *point d'appui.* The operation done, the needle is quickly withdrawn, and, the fingers being removed, the eye closes. In this brief and simple operation, every precaution must be taken against wounding the lens and making a traumatic cataract. This accident may occur whether the eye be steadied by the finger or by speculum and forceps, either when the needle is introduced, or when the last of the aqueous humour is let out. The operation is attended with little or no pain, even if anæsthesia be not employed; and, if the fingers and one instrument only (the broad needle) be used, the soft parts of the fingers give no pain, and the patient is but little alarmed.

### OPERATIONS ON THE IRIS.

**Artificial Pupil.**—In this operation a piece of the iris is either removed altogether, *excised* (iridectomy); or, by simple *incision*, an opening is made in the iris-tissue. The term artificial pupil is also applied to any operation by which the natural pupil is displaced and altered in shape and position, as well as to those by which an addition is made to the natural pupil, or those by which an altogether new opening is made in the iris itself.

There are many different directions in which an artificial pupil may be made: (1) central and downwards, or (2) down and inwards, or (3) down and outwards, or (4) inwards, or (5) outwards. The upper lid so much covers the upper part of the cornea and iris, that it is a forlorn hope only when the operation is done any way upwards, as a *direct* means of improving vision (see "Iridectomy for Glaucoma," p. 436).

Artificial pupil, *per se*, is called for in many very different cases.

1. In *Partial Opacity of the Cornea*, with or without iris-adhesions, it is required to make a pupil opposite clear cornea.

2. In *Total Posterior Synechia* (exclusion of the pupil), it is needed to re-establish communication between the anterior and posterior chambers, &c.

3. In *Closed Pupil* (occlusion), it is required to make a pupil opposite clear (uncovered) lens, &c.

4. In *Central Lamellar Cataract*, this operation is performed to bring the pupil opposite clear (non-cataractous) lens.

Next to cataract-operations, those on the iris essentially are those which the ophthalmic Surgeon is most frequently called upon to perform. They made nearly one-fifth of all the operations done in 1871 at the Royal London

Ophthalmic Hospital in Moorfields, without reckoning any of the very numerous *preliminary* iridectomies in cataract extraction and other operations. If an operation for artificial pupil be thought of in a case in which the natural pupil is quite obliterated, or where, in any case, even with atropine, an ophthalmoscopic examination of the fundus cannot be had, the Surgeon must first carefully ascertain that the eye retains perception of light. But, in order that the operation may be likely to succeed in restoring useful vision in such cases, the patient should not only have a perception of light, but should be able, when the other eye is closely covered with the palm of the hand, to readily perceive the shadow of the hand of the Surgeon when it is passed quickly before the light, between it and the eye of the patient, even at a distance of two or three feet. If there be a less degree of vision remaining, if the tension of the eyeball be plus or minus, indications of intraocular pressure, or atrophy, there must have been some deep-seated disease, besides the iritic inflammation, the immediate cause of the obstructed pupil. After estimating the degree to which vision is impaired in the case of proposed operation for artificial pupil, the Surgeon must observe accurately what evidence of past disease he can see with his own eyes, and compare all this with the history of the case. If corneal opacity be the reason why an artificial pupil should be made, the operation must be deferred until, after some months at least, no improvement by progressive clearing has taken place, according to the history of the case, or by the Surgeon's observation, no redness of the sclerotic has appeared around the cornea, and no former operation of the same kind has been attempted. A lad was admitted at University College Hospital for the operation of artificial pupil. He had had keratitis of both eyes some years before, and slight attacks more recently. He had been treated at intervals as an out-patient for a long time, with cod-liver oil and syrup of iodide of iron, &c. He was anæmic, and, apparently, lived poorly. When taken into the Hospital, he had full diet, and he sat, almost blind, by the fire with the other patients. Very soon he could see better, and in a short time the clear marginal part of the cornea was wider. When the operation was performed, a few weeks after his admission, it was remarkable how his corneæ were cleared, after they had been at a stand-still for months, if not for a year previously, according to the patient's own account, and the latter part of the time during which he had been under our own observation.* Of course, if there be ever any appearance of present, or any history of recent inflammation, any faint diffused nebula of the cornea and slight redness around it, it must be understood that it is not of that external nature with superficial vessels, due to granular lids, an inverted eyelash, or other mechanical means, but an affection of the cornea itself. One can only wait for the cornea to clear as much as it will, always from the margin, of course. The general health of the patient must be attended to, and belladonna locally may be of some use, meanwhile, as a sedative and mydriatic.

In any case of opacity of the cornea extending nearly to the margin, and allowing at no part any wider clear space for artificial pupil, the incision of the cornea must be made in the sclerotico-corneal junction and very little obliquely, so that the iris may be drawn out quite up to its outer circumference.

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* In cases of old hopeless leucomata, at a subsequent time to the operation for artificial pupil, if any such operation be done, the disfigurement may be entirely remedied by tattooing them of a somewhat darker colour than the iris.

Artificial pupil, if one eye *only* be diseased, is *urgently* required if there be total posterior synechia or numerous adhesions, and should be done, although the performance of the operation is not urgent, *if the patient incline to it*, in any of the other cases, even if the unaffected eye be perfectly sound.

**Incision.**—This is an operation not much in use. It is advisable perhaps only when the lens is no longer present, or, at least, is useless and of no account by results of operation or injury, and the iris has prolapsed through the corneal wound ; or when the pupil has been obliterated in consequence of iritis, the cornea remaining clear, and, there being no communication between the anterior and posterior aqueous chambers, the iris-fibres bulge forwards all round wherever they are not too tightly stretched. When they thus bulge, though a transparent lens may be supposed to exist behind the iris, it may perhaps be *safe* to incise the tense iris-fibres somewhat obliquely : but, in such a case, probably an iridectomy would be a better operation. It is probable, indeed, that mere incision for the formation of an artificial pupil, should be confined to those cataract-cases in which the extraction-operation has been followed by inflammation and closed pupil, with stretching of the iris-fibres. If, in such a case, the Surgeon anticipate inflammation to follow the secondary operation, one simple cut with a broad needle may be rapidly made across the iris fibres. In such cases, too, the iris may be fearlessly incised ; there is no transparent lens or no lens to be wounded. The vitreous humour probably protrudes through the opening in the iris ; and, if no fresh inflammation be set up, a good pupil may be made, and may remain (Fig. 567). Just after the operation, when the pupil is first made, it will appear, of course, to be good, because the aqueous humour has escaped, and the protruding vitreous body then makes it appear very black and clear.

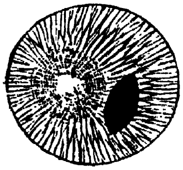

Fig. 567.—Incision of Iris.

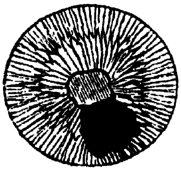

Fig. 568.—Artificial Pupil after Iridectomy.

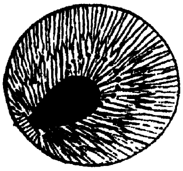

Fig. 569.—Pupil after Iriddesis.

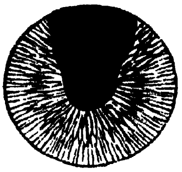

Fig. 570.—Iridectomy for Glaucoma.

*Operation.*—The eye being well steadied with wire speculum and forceps, or with the fingers, a broad needle, with a cutting edge not confined to the part near the point, is thrust through the cornea and then through the iris at one extremity of the intended incision, and, as it is withdrawn, it is made further to divide the iris-fibres to the other extremity of the aperture that is to be made.

**Iriddesis.**—Before this operation was invented by Critchett, there was an operation for artificial pupil, which consisted in effecting a prolapse of the iris by the cornea, and thus it was hoped an anterior synechia would result ; but, by tying the iris externally, it is secured, and cannot return, even partially, within the anterior chamber.

Iriddesis makes a regular outlined pupil, of moderate size, largest towards the centre of the cornea (Fig. 569). In these diagrams the cornea is never represented : a central leucoma is supposed to exist in the present instance. The dotted circle shows the place of the pupil before displacement. The operation does not cause bleeding into the anterior chamber, and its subsequent complications. The pupil may be larger or smaller, but not very large ; and as it is made, so it remains definitely. Iriddesis has been much in vogue for cataract of that "congenital" form (lamellar and nuclear) in which some layers, or some parts of them, are definitely opaque, if centrally, with a clear marginal part of the lens. This is a stationary form of cataract, and if atropine show a sufficient margin of clear lens, generally behind the iris, we may make there an artificial pupil by displacement and ligature, and let the patient have the use of the natural lens, rather than substitute a glass.

The *Operation* is done thus. The eye being exposed, and held with speculum and forceps, a broad needle is passed through the cornea at that part of the margin towards which it is desired to place the pupil. An assistant then places a little loop of very fine black silk over the opening on the wet surface of the conjunctiva, and leaves it there. To draw out as much of the iris as is required, either an ordinary silver iris-hook is used, or, if it be desired not to include the whole breadth of the iris to be prolapsed, and the pupillary margin is to be left free, a cannula-forceps is used to seize the iris midway between its greater and lesser circumferences. The part of the iris which is to be secured being now drawn out by the corneal aperture, the assistant, holding in each hand a forceps with broad ends, like those used for pulling out eyelashes, seizes the ends of the ligature, and, when desired by the Surgeon, tightens the loop and leaves it. This he does whilst depressing a little the ends of the two forceps, so as to tie the knot quite close to the cornea ; and he is careful not to pull the ligature more one way than the other, lest the iris be dragged on one side, or, being very delicate, and offering no perceptible resistance, it be very easily cut through. The ends of the loop are then cut off close to the cornea, the eye is closed, and both eyes are bandaged. If the knot have been sufficiently tightened, the portion of iris so strangulated and the little loop of silk will drop off in a day or two ; and the iris, meanwhile, has formed an adhesion within in front (anterior synechia).

But by this method of proceeding the *ultimate* results are often very unsatisfactory : the *iris is confined*, and a low chronic recurrent iritis, etc., may be set up, which leads to far worse results than the state of things which the operation was intended to remedy. These artificial anterior synechiæ seem to be as pernicious as are the common iritic posterior synechiæ. We have seen many instances illustrative of this disagreeable truth. An excision of iris is a far safer though less attractive operation. If iriddesis be ever to be done, we prefer the proceeding with cannula-forceps, seizing the iris midway, and not the pupillary edge, as in this way much less confinement is caused ; and when but a *slight* displacement of the pupil will effect the purposes of good vision, iriddesis may yet be permissible.

**Excision : Iridectomy.**—This operation is especially advisable when a considerable opacity of the cornea leaves only a very narrow marginal part clear : when iritis has caused occlusion of the pupil (Fig. 568), total posterior synechia or very considerable adhesions, which cannot be detached by the use of belladonna, or by operation: when perforating ulcer or other cause has ended in complete or almost complete adhesion of the pupillary iris to the cornea. But in all the cases requiring artificial pupil operation, an excision of iris is in a very large majority the best.

*Operation.*—An anæsthetic is first given, and the eye is kept open and steadied in the usual manner with speculum and forceps. An opening into the anterior chamber, of at least one-eighth of the circumference, is made in the corneal margin with an extraction (Sichel's) knife. If now it should be necessary that the eye be held in order that the corneal wound may be exposed, the forceps to hold the eye is handed to an assistant; and the iris-forceps, closed and held in the left hand, is introduced into the anterior chamber. A sufficient quantity of the iris is seized and drawn out; and, with the iris-scissors laid flat on the surface, it is snipped off close to the cornea. The operation, with extra precautions at the time and subsequently, is described below (see "Iridectomy for Glaucoma").

An artificial pupil should not be very small, as it will more probably become closed by subsequent inflammation, or, if not closed, contracted till it is much too small for useful vision. The iris must be seized with forceps: a hook may tear through rotten or firmly adherent iris, or will draw out too little. No blood should be allowed to accumulate in the anterior chamber, if it can be prevented. No clot should certainly be left between the edges of the wound in the cornea. And, if the iris, close to the part where it has been cut off still hang in either angle of the corneal wound, it must be returned with the little spatula made for this purpose, or with the end of the curette.

Besides the operation for glaucoma, for artificial pupil, and for recurrent iritis with adhesions, in which iridectomy is called for, there are a great many other cases in which iridectomy is now usefully employed. In some of them, as, for instance, in acute ulceration of the cornea and hypopyon, simple paracentesis corneæ may be sufficient; so that, if we doubt the necessity for iridectomising, we can give it a trial meanwhile. If, after an iridectomy for glaucoma or recurrent iritis, the disease return, the operation may be repeated: the portion of iris removed being *opposite* to that excised on the former occasion. An iridectomy *in the first instance* for total posterior synechia or for hypopyon, should be a large one, and upwards as in glaucoma cases.

**Iridectomy for Glaucoma.**—Although the common operation for artificial pupil, to which I have just referred, or for recurrent iritis, may be quite correctly called iridectomy, as it used to be before the cure of glaucoma was invented by Von Gräfe, yet the operation and all about it is widely different from that for glaucoma, as may be seen briefly in the following comparison of the two iridectomies.

| *Iridectomy to cure Glaucoma.* | *Iridectomy for Artificial Pupil.* |
|---|---|
| There is no permanent opacity of cornea, nor any obstruction of the pupil, leading to the operation. | The operation is done for permanent opacity of the cornea, or obstruction of the pupil, or both. |
| The cornea and lens may be becoming altogether hazy at the time. | Both cornea and lens clear, at least some part; at this the operation is done. |
| The globe is hard to the touch. | The globe may be soft, or hard, or normal. |
| The fundus would be well seen, but for | There is opacity or obstruction prevent |

| | |
|---|---|
| turbidity of the aqueous and vitreous humours probably, or haziness of the cornea and lens. | ing examination with the ophthalmoscope, quite irrespective of any turbidity of the humours, or haziness of the other media. |
| The operation is best done during inflammation. (When there is pain, &c.— in the acute cases.) | The operation is only allowable when no inflammation exists. |
| Operation cannot be deferred. | Operation may be put off without harm. |
| The excision is best made upwards, where it is covered by the upper lid. | The excision should be made any way but upwards: where most convenient, at any exposed part. |
| The piece of iris should be taken specially from the greater circumference. | The piece of iris should be probably taken from the pupillary margin. |
| The piece of iris excised should be large. | It should be small, or smaller, at any rate, than that in iridectomy for glaucoma. |
| The good result of the operation is immediate. | The good result appears after a while. |
| The pupil is never afterwards blocked up. | Not unfrequently resultless by secondary iritis and occlusion of the pupil. |

We see, therefore, in the first place, that in glaucoma the portion of iris to be removed must be taken from its whole width, quite up to its greater circumference (Fig. 570), so that the preliminary opening made into the anterior chamber must be in the sclero-corneal junction, or in the margin of the sclerotic itself; not in the cornea, as it should be generally in the formation of artificial pupil by excision. For glaucoma, the piece of iris excised must be larger than is usual for an artificial pupil; and, that the gap made when the iris is removed may be hidden, it should be beneath the upper lid, just where an operation for artificial pupil would be out of the question. The chief steps of the operation are the same as those described already for operation of artificial pupil. But, chloroform having been given, if desired, the wire-speculum and forceps being used, to keep open the lids and to steady the eye, an opening extending to one-fourth of the circumference must be made in the sclerotico-corneal junction, or even in the margin of the sclerotic, at the upper part. About one-fifth of the whole iris is removed in the operation. For this purpose, a lance-shaped knife is generally thrust into and across the anterior chamber, and the incision is extended, if necessary, as the knife is being removed; but an ordinary (Sichel's) extraction-knife is much preferable. It cuts better, requiring less thrusting force, and with it the wound in the cornea may be made less obliquely through the coats of the eye, nearer, that is to say, to the greater circumference of the iris, which we want to reach; and the point of the cutting instrument always between the cornea and iris may be kept quite away from the front surface of the lens, instead of being, as when the lance-knife is used, necessarily carried straight across it. In glaucoma, the anterior chamber is very shallow. The point of the knife, which may be held in the right hand for either eye if the operator be not ambidextrous, is introduced in the sclero-corneal junction, at the right extremity of the incision to be made, and carried a little way towards the centre of the anterior chamber; and, when it has well entered this chamber, the cutting edge is directed upwards and forwards, and being thrust onwards steadily, with a firm hand, so as not too quickly to evacuate the aqueous humour, is made to cut, aided perhaps by slight sawing movements up and down, rather vertically (not by making a counter puncture, as some recommend) as far along the extreme margin of the cornea or sclerotic as the length of the incision is to be made, at least one-sixth of the circumference. The knife, as it is withdrawn, is then brought once more with its point directed towards the centre of the chamber, so as to make a similar square extremity of the incision, to the end at which it was begun.* Then, as in the excision-operation for artificial pupil, the fine curved iris-forceps is introduced, and the toothed points opened in the anterior chamber (unless the iris have prolapsed, with the flow of aqueous humour, when the corneal wound was completed) widely enough to seize a rather large portion of the iris. This is then drawn fully out, and is first cut through with the iris-scissors vertically on the right side; then, the blades of the scissors being held flat on the surface of the globe, it is divided along its ciliary attachment, close to the opening into the anterior chamber, and, lastly, it is separated altogether by another vertical cut. The operation is then complete. If much bleeding into the anterior chamber occur, the blood must be, if possible, coaxed out in one way or another, before it has formed a clot. The point of the curette between the lips of the wound, or on its posterior lip, may do this; or the blood may be pressed out with the convex back surface of the same instrument, by passing it, wet with tears so as not to abrade the epithelium, from below upwards over the front surface of the cornea; or, by gently pressing back the wire-speculum upon the eye, it may be squeezed out. If there be bleeding, however, some blood will probably be left, and cannot be removed. The eye is tied up with some lint, wet or dry, over it, and a bandage is applied over both eyes.

**Diagnosis of Glaucoma.**—In the diagnosis of a case of glaucoma, much stress must not be laid on the meaning of the word—the *sea-green* colour in question is often not at all seen in the reflected light from behind the pupil. The chief diagnostic signs are these:—1. *Tension* in excess—varying from the least degree T. 1, to a stony hardness, T. 3. It is appreciated by the two fore-fingers, used much as in trying elsewhere to discover the existence of deep-seated pus, the patient looking down and gently closing the lids; or the amount of tension may be appreciated by the eye, as well as by the touch, by placing the point of the forefinger on the ciliary margin of the patient's lower lid, and indenting the globe as he looks up. 2. *Pain* in and around the eye, which is often intolerable, generally intermittent. Rarely does a case of painless (non-inflammatory) glaucoma occur. 3. *Halos* are seen around the light. 4. *Presbyopic* symptoms are present. 5. There is *narrowing of the field* of vision. 6. There are *obscurations*. 7. The *appearance of the eye* externally: *a*. Large tortuous vessels are seen to course over the sclerotic, and dip into it in the ciliary region; *b*. The anterior chamber is shallow, the lens, and the iris with it, being, by pressure from behind, thrust forwards in approximation to the back surface of the cornea; *c*. The pupil is large and inactive; *d*. The cornea has more or less lost sensibility, and reflects light from its surface imperfectly; *e*. The lens is perhaps cloudy (not cataractous, not opaque after iridectomy). 8. *Ophthalmoscopic appearances*. When the fundus can be seen (and it very often can be, though the aqueous and vitreous humours be somewhat obscured, even when the cornea looks steamy and the lens cloudy), the excavation, more or less, of the *entire surface* of the optic nerve-entrance, and tortuosity and congestion and pulsation of the retinal veins (and arteries), which are displaced and compressed against the white margin of the "cup," and some little ecchymoses therefrom, perhaps, are the marked features. These signs are all due to increased intraocular pressure, as is shown directly by the excessive tension (the first diagnostic sign given), in consequence of the contents of the globe being more than is normal.

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* This method of making preliminary corneal incisions in preference to those made with the thrust of a keratome or the counter-puncturation of Von Gräfe's knife (see Cataract, page 449) has, I am glad to find, been adopted on principle by some of my colleagues.

Glaucomatous is a term applied to symptoms of increased intraocular pressure (tension) in other diseased states of the eye, in which iridectomy is performed with much benefit to the patient : *hardness of the globe* being in any such cases whatever, the indication for the operation. As it is specially important to recognise glaucoma in its first stages, we must not look for the corneal and lenticular changes, or much "cupping" of the optic nerve in all cases of the disease, or the operation will have been deferred long after it should have been done. Glaucoma is a disease of elderly or of old people of impaired health. The earliest symptoms are, to the patient, perhaps, intermittent obscurations, halos, and more or less wandering pain ; and, to the Surgeon, increased tension, some congestion, dilated pupil, shallow anterior chamber, and ophthalmoscopically, some excavation of the optic nerve-entrance and venous pulsation. In the case of an eye blind by old neglected glaucoma, iridectomy will perhaps relieve pain ; but probably it should be extirpated.

The benefits of iridectomy, properly performed, and sufficiently early in glaucoma, are patent ; and it must be done, when the opportunity offers, even when the time most favourable for its performance is gone by, and even in the chronic cases, in which the results are always least advantageous. Without operation, glaucoma certainly ends in total blindness. It is probably, in the first place, choroiditis, and effusion in the vitreous space. It goes on by producing such structural changes in all the tissues of the globe, that total disorganisation is the result.

**Prolapse of the Iris.**—This means a bulging of the iris through an ulcer which has perforated the coats of the eye, or through a wound in these coats, either made accidentally, or in the course of a surgical operation. It is often caused by the first gush of aqueous humour as it escapes when the perforation is complete, and remains there passively until it is either pushed back into its place with a spatula or curette, or made to return by causing contraction or dilatation of the pupil by instillation of a solution of (atropine or) Calabar bean, one or the other, as the case may seem to need. It is evident that, if the external opening should be in or very near the centre of the cornea, a prolapse of the iris cannot occur ; it cannot be very far from the corneal margin, the position in which most of our internal surgical operations are commenced. If a prolapse is to be returned, *it must be done very soon* after it has occurred, or the iris will probably have become adherent to the margin of the external opening, forming what is called synechia anterior, or, compressed between the edges of the wound, the iris will have at least become strangulated. In iridectomy operations, however, it is an advantage that a prolapse of the iris following the current of the aqueous humour should take place ; for then we need not introduce to the anterior chamber the forceps by which it is to be drawn out.

In other cases, prolapse of the iris is caused by pressure of the aqueous or vitreous humour behind it, and is not brought about in any sudden or impulsive manner; it is then discovered as a little bag of a dark colour—whatever may be the natural colour of the iris. If, being recent, we hope to return the prolapsed iris intact, Calabar bean and a strong light may be tried; and the return may be aided, if the prolapsed iris be distended by the aqueous humour, by gently pressing it back with the end of a spatula, by puncturing the most prominent part with a needle and relieving the distension, or by closing the lids and making some pressure upon them and rubbing them gently with the finger. The iris bulging may be already adherent to the margin of the external opening and cannot be returned; yet it may increase by the opening becoming larger or by an increase of pressure from behind, and this we must guard against by artificially contracting or dilating the pupil, as the case may be, by continued pressure of a pad of wool and a bandage, or, if the prominence be much, by puncturing it, or, supposing it to have become firmly adherent, by snipping it off with a pair of small scissors.

In the old operation of extraction of cataract by a semicircular flap, the iris, which is to be left intact, often prolapses, and this is one of the chief difficulties of this operation. It occurs either at the time of the operation, the vitreous humour after the lens is gone, causing it to bulge forwards between the lips of the wound; or the iris is found, after some days, to be involved in the weak and slowly progressing cicatrisation of the same. In the former case it should be smoothly and gently pressed back into its place with the flat side of the spatula held horizontally, and then, all pressure being taken off the globe, the lids are to be closed and so the lips of the wound kept together. When the prolapse is discovered some days after the operation has been done, of course it cannot be returned; pressure may then be employed, or, if the prolapse be considerable, it may be punctured or incised, or, better still, the prominence, if sufficient, be cut off.

**Synechiæ: Corelysis.**—*Anterior Synechia*, or adhesion of the iris to the cornea, only takes place when the two have been brought together for a time by evacuation of the aqueous humour, generally by perforating ulcers of the cornea (see Prolapse, p. 440, and Iriddesis, p. 435.) *Posterior Synechia*, or adhesion of the iris to the lens, which is very much more common, results from iritis; and these adhesions, once formed, are seldom detached, as in any case they should be if only it be in any way possible: for, if not, an iritis can hardly be said to be *cured*. Posterior synechiæ may be numerous, or the whole round of the pupillary margin may be bound down to the lens—total posterior synechia or exclusion of the pupil: if this be so, no communication exists between the anterior and posterior aqueous chambers, the circle of the iris projects forwards around the central depression in which is the adherent pupil, and presents a very characteristic appearance by oblique illumination. It is important also, for it is an urgent call for an immediate operation: the communication between the two aqueous chambers must be re-established by an iridectomy. If posterior synechiæ be few, or even numerous, the iritic inflammation having subsided, a certain amount of permanent injury, a source of irritation, and a liability to recurrence of iritis, therefore, at any indefinite time, are left; but the damage, if there should be total posterior synechia, tends always and *at all times without intermission or hope of abatement,* to aggravate itself, by the *constant* dragging, the great tension that is kept up, by the accumulation of aqueous humour from behind, upon the iris between its greater and lesser circumferences, its ciliary and pupillary borders. Occlusion of the pupil is a very different case : it is when the pupil is filled by a false membrane after an iritic inflammation : the pupil may be, and is, very probably, also excluded, but if it be only occluded, it may not be bound down to the lens at all, and the aqueous humour may pass freely from the posterior into the anterior aqueous chamber through the occluded pupil : in some cases I have opened out the false membrane and made a central pupil, without at all interfering with the iris. (*Ophthalmic Hospital Reports*, Vol. II., page 311.)

If iris-adhesions be few in number, three or four perhaps, and these be not wide, if the iritis have occurred but once, at least two or three months previously, and the iris seem, otherwise healthy, able and ready to dilate, as much as could be expected, considering the adhesions, under the influence of atropine, and the latter remedy have been fairly tried (a drop of a strong solution placed in the eye three or four times a day for a week) and have failed, I have been in the habit of detaching them with a spatula-hook passed between the iris and the lens (*Op. cit.*, p. 309). There is no fear of wounding the lens. But, now, unless circumstances be altogether favourable, according to the above data, I am afraid of lighting up a fresh iritis and of getting re-adhesions after the detachment has been done. The results of *Corelysis*, as I have called it, are altogether encouraging in these favourable cases : the patient, not old in years or in general health, his iris fully dilated, and able to dilate, but for a few tense adhesions posteriorly by which it is distorted. But, in most cases, the adhesions are either more numerous and extensive, or they have been, just after the iritis, detached by the proper use of atropine : if this have not been and cannot be accomplished, and the adhesions be numerous or extensive, or both, the question of an iridectomy arises. If vision (the pupil) be much obstructed, together with the fact of the adhesions, an iridectomy, by way of artificial pupil, must be done. Without much impairment of vision, on the other hand, if the iritis should become recurrent, an iridectomy, larger and upwards, is required for the purpose of arresting the recurrences (see Iridectomy). If the pupil be somewhat blocked, besides the synechiæ, and there be recurrent iritis, still it is iridectomy. The two reasons for iridectomy coexist, and probably it will be desirable to make a rather large iridectomy down and inwards ; or a large iridectomy may be made in the usual upward direction, and, subsequently a small iridectomy, by way of artificial pupil, in the *opposite* direction.

### CATARACT.

Until within a very few years, it was considered an easy matter to determine, in any case of cataract, what operation should and would be done. One was a case for extraction (by a large flap, as it is now called), another as certainly would be removed by needle-operation, and a third by linear extraction, as it was called. Now every ophthalmic Surgeon is in search of some improved method which shall diminish the number of his unfavourable results ; and everything is changed for the better, or it may be for the worse. It is rather a bold thing, as far as the profession is concerned, to do an extraction as it is used to be done, making a semicircular section of the cornea, &c. This state of uncertainty makes it also very much more difficult to say what operation is meant by name, or to venture to recommend any particular operation in any case.

FORMS OF CATARACT.—Cataract is most common in old or elderly persons, and in them it is of the kind called **Hard Cataract.** In younger persons, and especially in children, cataracts are comparatively *soft.* The **Senile Cataracts** are generally striated ; the streaks being very evident in the commencement of the disease, and less seen as the whole lens becomes opaque : the lenses are generally a little amber-coloured, especially in the nucleus. The other cataracts are comparatively little or very indistinctly striated, and of a milky colour. . Striæ in the lens are almost invariably found to radiate from an opaque central spot to the circumference (Fig. 572), or to project towards the centre from various points of the circumference of the lens (Fig. 571). In fact the striæ, according to the direction of the lens-fibres, of which some only have become opaque, always diverge from or converge to the centre of the lens. In hard cataracts the cortical parts, as in the normal lens, are always comparatively soft, sometimes very soft, with a hard nucleus only ; but these are cases of secondary degeneration, by which, even the nucleus may at last become dissolved. In rare cases, an indefinite central haze, without any pattern, indicates the beginning of cataract. But there are not unfrequent cases of haziness of the lens, as a senile change, or from intraocular pressure (see "Glaucoma"), which must not be called cataract, for it is sometimes found together with good vision, and the haziness may disappear, or it may never go on to a complete or real opacity of the lens. It is not, in fact, the beginning of cataractous changes. This is an important distinction ; and no doubtful case must be said to be one of cataract, unless, by examination with the ophthalmoscope, by the direct or oblique methods of illumination, striæ or some certain opacities be seen in the lens, or such a degree of central haze in the same situation as to obscure the image of the fundus, when, by direct illumination of the ophthalmoscope, a *bright* light is thrown into the eye. If any less definite rule be adopted, it will lead to innumerable misunderstandings and false anticipations. When an eye, in which striæ exist in the lens, the rest of it remaining transparent, is examined by direct illumination, the pupil, of course, having been first of all dilated with atropine, the *mirror* of the ophthalmoscope only being required, the several streaks appear black, in front of the light behind them of the brightly lit-up fundus of the eye (Fig. 571) ; whereas,

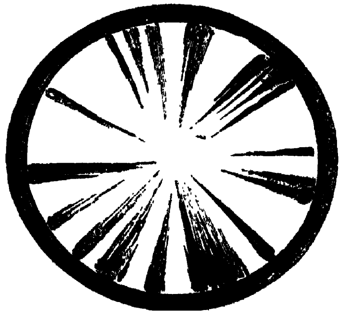
Fig. 571.—Commencing Cataract: Opaque streaks converging from the margin: the darker striæ are in the anterior parts of the lens.

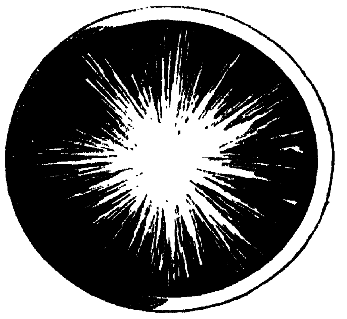
Fig. 572.—Commencing Cataract: Opaque streaks diverging from the centre. The lens-nucleus is altogether obscured.

when a commencing cataract is examined with a side light, and the ophthalmoscope *lens* only used (oblique illumination), the striæ appear whitish against the dark pupil; for the light is reflected from the front surface of opaque parts of the still partly transparent lens (Fig. 572). Thus, by these two methods, we have, in doubtful cases, a means of checking our diagnosis. The cases of *hazy* central commencing opacity of the lens, which are to be called cataract, have been defined already. Of course, in case of a patternless non-striated opacity of the lens, far advanced, the *whole* lens so evenly opaque that no part of it allows an inspection of the fundus, there need be no question of the existence of cataract. That the opacity is not in the cornea, or in any part behind the lens, is found at once by observing the apparent change in the relative position of the parts, when, in a good light (oblique illumination), the observer moves his head from side to side, whilst the patient keeps his eyes fixed on some other object. That it is no opacity in the pupil, is known by the use of atropine, which must of course always be used beforehand for the diagnosis of cataract, in doubtful cases, and which will not regularly dilate the pupil if this be not free. Of course there may be obstructed pupil and cataract behind it; but then we cannot certainly make out the latter. Or, if there have been iritic effusion and adhesions now freed, there will be evidence of old iritis. Or, if the opacity be in the vitreous space, it will be evidently so far behind the level of the pupil as to show its situation by oblique illumination.

Besides the idiopathic, there may be, at any time of life, **Traumatic Cataract.** Any wound of the lens, unless it be a slight clean cut or puncture, and not very deep, is followed by opacity of the whole lens. The surgical treatment of senile or hard cataract, of soft cataract, and of traumatic cases, is very unlike in many respects. In the latter only is there urgent need of any operation being done. Wounds of the eye (and lens), as of other parts, when they have occurred, are generally found to have been in young persons, or at least not in old people. Hence traumatic cataracts generally resemble the more the soft cataracts, so called, in being soft and whitish. In older persons, when the opacity follows a wound of the lens, it will be found to have a hard nucleus, if it be not altogether hard. The wounded lens becomes opaque, swells up considerably, except the nucleus in old people, and in young people very rapidly, by the admission of the aqueous humour; and herein usually lies the urgency of the call for surgical interference. The swelling of the whole lens and the gaping wound of the lens-capsule, by which an irregular protrusion of swollen lens-matter takes place, if the lens be not wholly swollen, press upon and rub against the iris and ciliary processes in their movements, and set up iritis and deeper-seated inflammation, which will not, of course, subside until the exciting cause is removed. Those opacities of lens, also, which follow blows on the eye, or severer blows on the head (without any external wound of the eye), by which the lens is dislocated (or *partly* separated from its natural connexions, so that it, and consequently the iris, are somewhat tremulous), must be included among the traumatic cataracts. It is in traumatic cases, accidental or surgical, and in these only, of cataract, that no delay is permitted if an operation be required: the curette, the suction-curette, or the spoon must be employed at once, and as much of the cataractous lens matter removed as can be without much interference.

Cataracts affecting, for the most part, only the cortical fibres of the lens, have been called *Capsular*. **Anterior Capsular Cataract** shows of course the shape of the convex surface as it is seen in front and just behind the pupil. In **Posterior Capsular Cataract**, there commencing, the striæ appear concave and rather yellow, not white, because they are seen through the thickness of a lens which, by age, is yellowish, as are all old lenses, cataractous or not; and some of them, without being cataractous, have yet a slight haze in them, nevertheless not a commencement of cataract. Secondary cataracts, consequent upon some disease of the deeper parts of the eye, are seen commencing in the centre of the posterior surface of the lens. Capsular cataracts are only commencing cataracts, where the opacity first appears in the cortical layers.

GENERAL REMARKS ON OPERATION.—If cataract begin as a stellate central patch in the lens (Fig. 572), of course vision is at once much interfered with, and is probably benefited by the use of atropine from time to time; whereas, in both these respects the reverse is true, if the striæ project only towards the centre from the circumference of the lens (Fig. 571). In any case, even the most complete, of cataract, it must be remembered that, though the fundus of the eye cannot be seen by the Surgeon, the patient can always, if the case be uncomplicated, see a bright light very well, the other eye being covered, and can at once equally tell the absence of it when the hand is before it. The "field of vision," also, within which the patient can see the light, is not reduced in size. The patient has not the hopeless look of blindness of an amaurotic patient; he seems to look for the light and to enjoy even such vision, of light only, as he has left to him. So it is also in any case of non-nervous blindness, in leucoma, &c. Also, in the diagnosis of a case of cataract to be operated on, one expects to find a pupil ready to dilate well or to contract, a good-sized anterior chamber,—in fact, an apparently healthy eye but for the cataract; no increase or decrease of tension of the globe; no history of former pain, and so on. Arcus senilis is no reasonable objection to operation. Cataract, unless it be traumatic, in which case the history is our guide, and the lens becomes cloudy in a few hours or days, is, of course, comparatively of slow formation, very slow indeed in the senile forms; but blindness or partial blindness in one eye from cataract, or indeed from any other cause, without pain or redness, is not unfrequently discovered suddenly and by chance, by the patient accidentally closing the other eye, with which he has been seeing, so that the history given us may require a complete mental refutation, lest we be led to fear any unfavourable complication not existing in the case.

An *incompletely opaque lens* must not be operated on for its extraction if the operation can be deferred or avoided: but it cannot be in some cases of so-called congenital cataract, in which the lens opacity is central and so large as to need the loss of the whole lens (see, on the other hand, Iriddesis), or in cases in which very slowly progressing senile cataract has produced so considerable a *central* opacity in the lens of *both* eyes of a patient, as, without rendering the lens of either completely cataractous, to have made the patient practically blind. Then either one may use the needle once or twice beforehand, and, the whole lens having consequently become opaque, it may be regularly extracted; or the risk and danger of extracting immature cataracts must be borne. (I have had no practical experience of the extraction of cataract *in its capsule.*) For portions of transparent cortical lens-matter are sticky, and adhere to the portions of lens-capsule remaining in the eye after an extraction-operation, and to other parts; besides, if they were not thus difficult to remove, and did not require much interference for their removal, they are transparent at the time, and so cannot be seen to be removed. The preliminary needle-operations are not very satisfactory in practice: for the central, very slowly progressing cataracts, equal in each eye, of old people, needle-operations are in themselves rather dangerous (see p. 452), and they take much time whilst one is striving to hasten the end; for two needle-operations or a following extraction-operation cannot be done at short intervals safely, and a senile cataract very slowly becomes opaque, even when the capsule is opened, and an iritis is never improbable. The congenital forms occur in younger, perhaps very young patients; and, very often, a needle-operation having been done in order to the maturation for extraction of one of these cataracts, it will be found better to complete the operation by repeated use of the needle only.

If one eye be cataractous, the other still retaining more or less the useful vision, the cataract may be operated on, if complete and otherwise fit for operation: but it cannot be right to urge the operation which may well be deferred, and need not now be done. If the seeing eye show a commencing cataract, a patient will, not unfrequently, desire the removal of the complete cataract, so as to have prospectively the use of the then practically blind eye when the other fails him. If the seeing eye do not show any commencement of cataract in it, the history and examination of the case require more particular attention in order to its diagnosis—that it be not traumatic, or, if it be, at least that vision, independently of the cataract, be good. Perhaps operation may be advisable. I have sometimes, for cosmetic reasons, extracted a cataract in a blind (amaurotic) but otherwise, externally, healthy-looking eye. Even with the densest or darkest coloured cataract the patient has, in an uncomplicated case, a good perception of light and field of vision. If there should be cataracts in both eyes equally advanced, both fit for extraction, I prefer to do one first and the other a few months afterwards; but I would not refuse to extract both at once if good and special reasons were given for my doing so. I have known both eyes to be lost after a double extraction.

The object of the operations for cataract is the removal of the opaque lens from the axis of vision. Subsequently to the operation, instead of the natural lens, an equivalent glass lens is placed *before* the eye—for near objects about 2½, and for distant objects about 3½ inches focus. The points to be observed are, either the getting rid of the cataract very gradually by natural process of absorption, when, in young persons, the capsule being lacerated, and the lens wounded, by operation from time to time, this can be accomplished; or, otherwise, the more rapid removal of the cataract, the opaque lens-matter, by laceration first, and then evacuating by as small an opening as possible in the cornea; or, thirdly, by extraction of the whole at once by a sufficiently large opening. After the operation, we have merely, as a general idea, to let nothing, by any movements brought about directly or indirectly, hinder the healing of the external wound, or interrupt the complete rest and seclusion necessary for the recovery, without inflammation, of the various internal structures that have been disturbed.

Before any cataract-operation, belladonna or atropine drops may be well used, although, if the aqueous humour be let out, the iris will contract at once. At any rate the application keeps the pupil dilated in the beginning of the operation, so that one can see well the cataract ; it shows also that the pupil *will* dilate, and how much it will dilate, and it inclines the pupil to dilatation during the operation and subsequently. I do not think that the iris is ever brought any more in the way of the cutting edge of the instrument used in opening the cornea, by its expansion, as is asserted.

In any operation for cataract, care must be taken not to urge the vitreous humour to escape, nor inadvertently to rupture the posterior lens-capsule, nor to bruise the iris or cornea ; and not to leave any lens-matter or clot of blood, not only in the former situation of the lens, if, without much interference, they can be thence removed, but also in the lips of the corneal opening, where they will interfere with the healing process.

Formerly, when the only method of extraction of senile cataract was by a flap involving a section of one half the circumference of the cornea, very many precautionary rules were to be enforced that are now of little or no importance. Then cataracts were only extracted in the spring time—the time we now only consider to be best. Then, if a patient were intractable, the prognosis was very unfavourable, if the operation were done at all. Now, the administration of chloroform during the operation, and perhaps of chloral subsequently, have almost set aside this objection. The great extent of the surgical wound in the cornea, then deemed indispensable, was naturally an evil prognostication if the patient were feeble, lest the section should never heal, or the cornea die of malnutrition ; or, if the patient had an habitual cough, it was ominous of vitreous escape through so large an opening, or of prolapse of the iris at least, in the same way. Iris-adhesions, always unfavourable, when no iridectomy was done, were a fatal objection to an extraction. Our patients now-a-days have great advantages at least in the improved methods of extraction. But no result of any surgical operation is so beautiful as a *successful* extraction by the old semicircular flap ; and, all things being favourable, the patient completely anæsthetised, it may still be done in some few cases.

HARD OR SENILE CATARACTS are extracted wholly and at once by one of the three following methods.

**Extraction by Flap-Operation.**—The old operation of extraction by a semi-circular flap is thus done. The patient is lying on his back on a high couch with his feet to the window ; the Surgeon standing behind him, having cautioned the patient against any irregular movement on his part, puts his forefinger against the lower edge of the patient's upper lid, using his left hand for the right eye of the patient, and *vice versâ*, raises it, and holds it securely against the upper margin of the orbit. The middle finger is put on the surface of the globe, on the nasal side, to keep it from rolling inwards. An assistant has charge of the lower lid, which he depresses and holds securely against the edge of the orbit without any pressure on the globe itself. The Surgeon, with the extraction-knife, held like a pen in his other hand, again cautions the patient, tells him to look towards his feet, and, resting the hand with the fourth finger on his cheek, enters the point of the triangular knife (Sichel's) at the outer side of the cornea, near its margin; then, not allowing the eye to be rolled in, he thrusts the knife rather quickly across the anterior chamber in front of the iris, and penetrates, from within, the cornea at the inner side, making the counter-puncture just opposite to and symmetrical with the first; so that the upper half of the cornea is in front of the knife or before its cutting edge. The knife is now only thrust onwards as far as it can be, until the flap is completed: but this, very probably, cannot be done but in drawing the knife back again a little, or by little to-and-fro movements. Until the section is nearly completed, and the knife has passed in front of the whole iris, it must not be at all retracted; or the aqueous humour is allowed to escape, and the iris falls in front of the cutting edge. The lids are now freed, and the patient told to keep them gently shut. After a short rest the lids are held open, but they need not be again so firmly fixed as before; the patient is then told again to look down, the convex back of the pricker, held horizontally, is inserted between the edges of the corneal wound, carried down to the pupillary area, and turned with its point against the capsule of the lens. Then, by a few light scratches, this is freely lacerated and the instrument withdrawn, with its back turned upwards, so that its point may not be caught in the iris or cornea. The eye is again closed for a minute, and when again opened, it is by the operator only, who raises the upper lid as before, but without much pressure against the edge of the orbit, and then he places the convex back of the curette horizontally on the skin of the lower lid near its margin. With this he makes intermittent light pressure on the globe just below the ciliary region, and synchronous counter-pressure with the point of the forefinger, which is holding the upper lid at its margin against the ciliary region just above the corneal wound. This requires much tact and attention. If the globe be compressed too far back, the lens will escape violently, and not improbably with some of the vitreous humour. If it be compressed too far in front, the lens may be dislocated, but not out of the eye; it may fall back into the vitreous space and be lost. If all go well, the upper edge of the lens is seen to come forwards through the pupil which it dilates, and then rides over it and presents itself in the corneal wound. The pressure should be kept up or increased, until little by little the lens has advanced so far that at least more than half is without the wound. Then, the pressure exerted being little and equal, the lens, if it remain in the wound, may be rolled out sideways with the tip of the middle finger of the hand which steadies the upper lid. This is better than increasing the pressure up to the final evacuation of the lens, as vitreous humour may follow it, and better than omitting altogether the pressure exerted, or much of the softer cortical parts of the lens are likely to be detached and left in the lips of the wound and in the anterior chamber. Any such are in the next place removed with the curette, if it can be done without much interference. If the iris be now inclined to prolapse, it may be pressed gently back with the small spatula, made for the purpose, held horizontally. The instruments, knife, pricker, &c., are all held horizontally; so that if the eye, ill controlled by the patient or Surgeon, should, in any stage, roll upwards, as it has a tendency to do, the instrument in hand may not pass downwards into the deeper parts of the eye, but be forced out of it by this movement. The iris now being in position, the pupil clear, and nothing being left between the edges of the corneal wound or within the palpebral aperture, the lids are gently closed, a smooth oblong piece of linen rag, with a slit in it for the nose, is placed over both eyes, then a little wool is put in the orbits over the rag, and a bandage over it round the head. The patient is kept in bed for a day or two, and fed with spoon meat. He may then get up and walk about the room a little.

**Extraction with a Traction-Instrument.**—In this operation chloroform is given, and a wire speculum to keep open the lids, and forceps to hold the eye, are used. The Surgeon either thrusts in at the upper part of the sclerotico-corneal junction a lance-shaped knife in his right hand, or, what is preferable, the point of a Sichel's extraction-knife, at the right extremity of the incision which he intends to make in this part of the eye, and, holding it almost vertically, he cuts on as far as he intends, perhaps one-fourth of the circumference, to the left. He then makes a considerable iridectomy, larger than for artificial pupil, and not so large as in a case of glaucoma. Then with the pricker he lacerates the lens-capsule. He then passes the end of the traction-instrument (Critchett's spoon) between the lips of the wound, vertically, to the upper edge of the lens and within the capsule, rather posteriorly; and, remembering anatomically the curve of the hinder capsule, he passes it along the curve just behind the lens itself. He then tilts forwards the end of the spoon, and, watching that the lens is coming with it, he begins to withdraw the instrument and the lens together. If the spoon will not go on between the lens and its capsule, it may be introduced perhaps a little sideways; and as soon as it has begun to pass between the two, it may be passed all the way without difficulty. If the lens is being pushed before the point of the spoon, instead of the latter passing behind it, it will be seen, the front surface of the lens being purposely watched, to be passing downwards; and we must try some other way, sideways, as above directed, or further backwards, and not of course push on the instrument so as to displace the whole lens downwards. The piece of iris excised must be so large that what is left does not become compressed between the spoon and the cornea, in the removal of the lens; and the corneal opening must be so large that not much dragging is required. The main body of the cataractous lens being extracted, the concavity of the posterior capsule, in which it rested, is pressed forwards by the vitreous body behind it, and so, if any fragments of opaque lens be on it, they are presented forwards in the pupil, and a spoon may be employed once or twice for their removal. No blood-clot, nor any lens-matter, nor, of course, the edges of the iridectomised iris, must be left in the corneal wound.

**Extraction by Von Gräfe's Method.**—This operation has in recent years grown immensely in favour with ophthalmic Surgeons, and almost all senile cataracts are now extracted in this way; or, at least, this operation is the grand foundation on which individual operators have built their modifications in details according to their own inclinations. First of all, we may observe that the idea seems to be based on two principal facts: 1st. That, to extract a cataract, it is not necessary to make so large an opening as a half section of the cornea, as in the old flap-operation—

which, indeed, became clear to us some years ago, when the traction-instruments were invented; and 2nd. That it is equally unnecessary as a rule, even with the smaller opening, and very undesirable on all accounts if its use can be avoided, to introduce any traction-instrument within the eye, as is done in the operation last described. (If Von Gräfe used any such aid in any case, it was a small blunt hook instead of a spoon.) The incision is made with a knife like a sharp-pointed tenotomy-knife, by puncture and counter-puncture, of perhaps one-fourth of the circle of the sclerotico-corneal junction. Attached to the corneal flap is left a flap of conjunctiva to cover the incision. An iridectomy is made, and, of course, the lens-capsule is lacerated in the usual manner. To evacuate the lens, the back of the curette is pressed against the sclerotic margin of the incision, and the necessary counter-pressure below is made with the fixing forceps. The cortical lens-matter generally remains to be removed, after the nucleus has come out or has been removed by the hook placed under and around it.

Von Gräfe says that the advantages are the following:—1st, the incision is linear; in consequence of which the co-aptation of the edges of the wound is more perfect than is the case after a flap incision, and there is less risk of gaping of the wound, permitting loss of vitreous humour after the performance of the operation: 2nd, it is peripheral, passing chiefly through a vascular texture, in which the healing process occurs more rapidly than in a non-vascular tissue: 3rd, the incision may be viewed as subconjunctival, being covered by a flap of conjunctiva: 4th, a portion of iris is removed, and thus no prolapse of iris can occur, and the tendency to iritic inflammation is diminished: 5th, in most cases no instrument is introduced to assist the evolution of the lens, and, when such is necessary, a hook merely is employed; and 6th, the after-treatment is of short duration.

Now probably no extraction by Von Gräfe's method is ever done in all its stages, exactly as Von Gräfe used to do it, and no operator is free from all prejudice in favour of his own particular modifications, which indeed to him only, it may be, are advantages in operating; but some few practical remarks as to my own experience of this now established method of performing the most important of the capital operations in eye surgery may be useful. The pupil is under the influence of atropine. The anæsthetic preferred may be fearlessly given; and, the patient being well under its influence, a spring speculum (Fig. 564, *a*) is introduced between the lids, and the eye itself steadied by grasping a considerable fold of conjunctiva at some distance below the lower margin of the cornea, with the toothed forceps (Fig. 564, *b*). For either eye to be operated on, I stand, as usual, behind the head of the patient lying on the couch, and hold the forceps generally in my left hand, because, in my way of making the corneal section, the knife for either eye may be as conveniently held in the right hand. I prefer a Sichel's knife, as in iridectomy (p. 436), in the present operation; not that there is anything to be feared in wounding the lens, or that it cuts better than Von Gräfe's, but because with it a section of the cornea can be made less obliquely in all its extent than by puncture and counter-puncture, which, in iridectomy for glaucoma, is also an advantage; and especially because, *with so small a section of the cornea* as is now made, the counter-puncture extremity of the section, when a counter-puncture is effected, *makes so small an opening in the anterior chamber as compared with its size externally*, and this is a deception, for of course its least dimensions are only practically available in the evacuation of a lens. The point of the knife being directed towards the centre of the pupil, the cornea is transfixed at its upper margin at the right hand extremity of the intended incision; the point of the knife is then carried on between the cornea and iris along the upper circumference of the anterior chamber. No counter-puncture is made, but the knife is quickly brought into a more vertical position, and with a firm hand, and quickly, by little to-and-fro movements, the section is continued as far as need be to the left extremity of the intended opening. That this extremity may be square like the other, and not at all oblique, the knife should be either drawn out at the end of the section, held quite vertically; or, the knife being held horizontally, the edge is brought upwards and forwards, and its point is made so to cut its way out suddenly at one stroke. The corneal opening should be as large as one-third of the circumference of the cornea; it had much better be unnecessarily large, than a little too small in any case; it is easily extended at either end, if it should seem to be necessary, by re-introduction of the point of the knife into the anterior chamber, and cutting right or left. No conjunctival flap is left to cover the wound: it is doubtful if, when it has been left, the corneal wound heals any the better. A considerable iridectomy is as usual made (p. 448), and the lens-capsule opened (p. 447). To evacuate the lens, the back of the curette, held horizontally, is now pressed on the globe between the lower margin of the cornea and the point below it, at which the globe is held with the fixing forceps. By moderate pressure backwards, gradually increasing, and by a succession of little sliding movements from below upwards, never reaching the edge of the cornea, the upper margin of the lens will begin to protrude at the corneal opening, and dilate it: as soon as it is certainly advancing out of the eye, the sliding movements must be discontinued, and the simple, very gradually increasing backward, and upward pressure alone is to be kept up on the eye or the lens; its largest part not having passed the opening, may recede as well as advance alternately with each up and down movement of the curette, and the extraction might never be completed. This steady backward pressure is to be kept up patiently until the largest part of the lens is certainly quite outside the corneal opening, when the whole body of the lens will probably fall aside out of the way, or it may be pushed aside, only not with the curette, for the pressure must not be altogether intermitted. At least we are no more concerned about it, and have only now to care for the complete removal of all the softer cortical lens-matter left behind in the anterior chamber. The curette is continuously pressing on the lower front part of the globe, and now again the sliding movements upwards may be recommenced, still not reaching forwards beyond the lower margin of the cornea; by this the vitreous body advances still more, and the lower part of the iris and cornea are brought into contact with it first, and soon, the pressure and upwards sliding movements being continued, the lower margin of the pupil is seen to be quite clear and black. The curette may now be slid a little up on to the lower part of the cornea; the opaque soft lens-matter will then rise higher, and so gradually, as it is seen to advance, and the clear pupillary space to become larger and larger, the curette pursues it until it is just all outside the corneal opening. At this stage, of course, the slightest continuance of pressure would lead to an escape of vitreous humour. If the curette be at any time slid upwards too soon, so as to get in advance of some of the soft lens-matter, the tendency is to push it back from the corneal outlet, and it will probably never be made to escape, or vitreous humour will be lost. No fragments of lens-matter must be left in the corneal wound or between the lids. A drop of atropine may be placed between the lids. A piece of fine linen (about 6 × 3 inches), is placed over *both* eyes, a little pad of fine wool is placed in each orbital space, and over this is fitted a Liebreich's bandage of elastic knitted cotton, and tied comfortably tight.

Sichel's moderately pointed knife cuts through the cornea better than the very obtuse keratome, or the very acute Von Gräfe's extraction-knife; and in the way it is recommended to be used, the inner and outer openings of the cornea may be made of the same size, square at both extremities, less obliquely through the coats, and the pupillary area is never transgressed. The incision may be less easily done, and less rapidly than is a single movement straight forward with a cutting instrument; but, for the curved incision, a previous determination of the line to be followed and a firm free hand only are needed.

*Escape of the vitreous humour* is the most important mishap in a cataract extraction operation that is likely to occur. It is not that the loss of any small portion of vitreous humour is in itself very prejudicial, but it is not often that a very small portion only does escape: if a little escape, it is probably followed by more; and the quantity is hardly recognised at the time. If vitreous humour be lost in the operation, it influences the ultimate result unfavourably; the eye is so much the less safe as an organ of vision hereafter, though the proximate result of the operation is successful. In the serous fluid occupying the place of the aqueous chambers and of the lens and the vitreous humour that is lost, the iris falls back out of its place, leaving a very deep anterior chamber, as it were, and has also probably got adhesions posteriorly to some new false membranes. And all synechiæ are, as I have said, in any case, incompatible with the prospect of safety for the future result. But if vitreous humour escape in any cataract operation *before* the lens, or that portion of the cataract which it was intended to evacuate by the operation, the operation is seriously marred; for if then the lens-matter be removed—and, the vitreous body having got precedence, it very likely cannot be,—more and more of the vitreous humour is allowed to escape by necessity. Even if the major part of the lens be after all removed, the prolapsed vitreous body will retain some considerable fragments and press them aside against the iris and ciliary body, and so very likely mechanically set up inflammation. The Surgeon is bound to be alert in detecting the least tendency to or beginning of prolapse of the vitreous body: the opaque lens-matter, instead of advancing, perhaps recedes a little, and soon a small transparent bead appears in the corneal opening. This opening very likely is too small, and needs enlarging; but after this, when the vitreous humour has shown itself once in the wound, still it would be dangerous to attempt the evacuation of the cataract by pressure; a sharp hook for a hard cataract, or a spoon or the suction-curette for soft lens-matter, may be used. Sometimes vitreous humour will escape at the close of the operation, after the lens has been removed; this is insomuch less serious; but at all events, if vitreous humour have escaped before the lids are closed and bandaged, the escaping vitreous body should be divided across close to the corneal opening with a pair of scissors; then the wire speculum is raised a little from off the surface of the globe to remove its weight, and to prevent the action of the orbicularis upon it; and then, this muscle being at the time tolerably passive, the speculum is removed and the eye quietly closed. In the old semicircular flap-extraction operation, vitreous humour was, perhaps, more frequently lost than it is in Von Gräfe's operation; but then, in the latter operation, it is more likely to anticipate the evacuation of the lens.

*Dislocated Lens.*—If the whole lens, or the greater part of it, have fallen into the vitreous chamber, the attempt is to be made to transfix it with a long needle or sharp hook, and remove it; but, lost to sight—and the ophthalmoscope cannot, in this stage of the proceedings, be employed—it can seldom be reached. Sometimes after a blow, a lens, perhaps already cataractous, becomes separated from its attachments, and, in its capsule, dislocated into the anterior chamber or the vitreous space. In the former situation especially it must be removed at once (because of the mechanical irritation and consequent inflammation of iris and ciliary processes to be anticipated), by a sufficiently large opening in the cornea, made with the point of a cataract-knife—care being taken meanwhile not to press the lens back again through the pupil: if this be avoided, it will in all probability readily enough escape when the incision is completed. I have seen a lens half-dislocated through the pupil, and held by the sphincter iridis. The iritis set up in this case was, of course, very acute. A lens, dislocated into the vitreous space, if quite separated and fallen to the bottom of this space, would be probably visible with the ophthalmoscope even although it were transparent, and had not yet become cataractous. It must be brought forward into the anterior chamber and removed by use of a long needle or a sharp hook, introduced through the sclerotic or in any way most convenient to secure it, if it can be done; but it is very difficult to do this, especially if the lens be still transparent. If the blow have burst the globe, the lens will be found in some cases beneath the conjunctiva, external to the globe. The rupture of the globe is probably in or just behind the ciliary region; and the lens is lying beyond it, further from the cornea. It is seen as a rounded semi-transparent prominence, probably *under the upper lid and far back*, and it is easily removed by opening the conjunctiva underneath which it is lying. Sometimes a lens or cataract is half-dislocated into the vitreous chamber, that is to say, it is held still partly by the suspensory ligament, as by a hinge, and, fixed here, it can move to and fro; it also, of course, must be at once removed. Indeed, a lens, cataractous or not, dislocated, or half-dislocated in any direction, is to be removed—if it can be done; for the lens, if transparent, is not in position to be of use, and beside this, in all probability it must soon become opaque.

SOFT CATARACT.—**Needle-Operation** is the method to be preferred for *soft* cataract at any age, so that we have only to determine which is a soft cataract. It is not often found but as "congenital" cataract, or in traumatic cases in young persons. Diabetic cataracts are soft. If a middle-aged or elderly person have soft cataract, it is, as in infants and young persons bluish-white, rather uniform in colour; it has no hard nucleus; and, especially, it is not at all amber-coloured. If, in any cataract case, a needle-operation be necessary, it should be done without much delay. The earlier in life, and the sooner after the commencement of the cataract, the more quickly it will be absorbed afterwards. Infants, unless at the time very young or sickly, should be operated on; or their eyes, when they begin to observe objects, get wandering oscillatory movements as a confirmed habit in after-life: and infants particularly well bear the risks of swollen lenses. Though the lenses of young persons, and still more of children, swell up much more, and more rapidly than do those of adults, or still more of old people, when their capsules are lacerated accidentally or by surgical operation, the iris and ciliary processes in them seem very little inclined to take on inflammatory action by the pressure and mechanical irritation of the, in these cases very soft, swollen lens-matter. The immediate result of the use of the needle in this operation is, that the cataractous lens becomes very much increased in bulk by the admission of the aqueous humour within its capsule.

*Operation.*—The needles used should be very fine, and should not let the aqueous humour escape beside them. The pupil is to be dilated with atropine, which must be constantly employed in these cases during all the surgical treatment. An anæsthetic is sometimes necessary. A stop-speculum is inserted between the lids, to keep them apart; and a little fold of conjunctiva and subconjunctival tissues is to be seized with the toothed forceps just below the cornea, or opposite to the point at which the needle is to be introduced, as may be most convenient, to steady the eye. The needle, held in the other hand, is made to enter the anterior chamber through the cornea, at some part near the margin, wherever it may seem best, probably at the upper and outer part; it must not be passed very obliquely through the coats of the cornea, or in its use they will be much twisted. The point of the needle, having passed the pupillary margin, is then carried on down to the centre of the anterior surface of the lens, which is nearer to the cornea, according to the youth of the patient, and made to enter its substance a little way, and the capsule is torn open by moving the needle-point in various directions to and fro. If the operation be performed for the first time in a very young patient, the lens is so soft that it is very readily broken up by the to-and-fro movements, and by rotation of the needle (drilling), but it soon afterwards swells up very much, and therefore but little should be done. If the needle be passed far into the substance of the lens towards the nucleus, it will, unless the patient be very young, become fixed in the denser substance, and the lens will move about as a whole on the needle, and may become dislocated. If the patient be older, or have been before operated on, one needle will not, perhaps, freely lacerate the tough anterior capsule, and two may be required. The fixing forceps must then be entrusted to an assistant; or, one needle being entered some distance in the anterior chamber, it may be used, the patient being then quiet, for an instant, as a fixing point, holding the eye forwards, until the needle in the other hand has been also entered, and then the eye is perfectly under command. If one needle only be required to be used, it is better to use neither speculum nor forceps, but the fingers of the other hand (Fig. 566) instead of both, unless the eye be small and deep in the orbit. If two needles are to be used, the speculum must be employed, and then, choosing an opportunity when the eye is still, one needle, and then quickly that in the other hand, is introduced ; and the operation is completed with the two needles, opening out the lens, whilst at the same time they keep the eye steady.

The needle-operation is always the best for infantile cataract. So, in childhood, if one of these so-called congenital cataracts have been left so long for operation, it should be broken up with the needle for its ultimate gradual removal by the natural process of absorption. Children and young adults hardly ever have any other kind of cataract than the congenital, unless it be the result of some wound or mechanical injury of the lens: then also, if the lens have become opaque, unless already the lens-capsule be sufficiently lacerated, the needle must be employed at once, and again and again whenever it may seem to be necessary to expedite and complete the process of removal, after a longer or shorter time, according to the rapidity with which the absorption proceeds ; and this will be more or less, in inverse proportion to the age of the patient. Though the anterior chamber is so small and the iris so close upon the lens, in infancy, still it seems that nothing is to be feared. In no juvenile cataract will it ever be necessary to make a large opening and remove the lens as a whole.

If the lens, wounded either accidentally, or by the surgical operation, swell much, or, whatever swelling occurs, should there be any symptoms of inflammation of the iris and ciliary processes, more at least than a very slight redness in the ciliary region and no marked tension, which may be disregarded, (and this is more likely the older the patient may be,) the process of absorption is arrested ; the lens-matter, or some of it, must for both reasons be removed at once by use of the broad needle and suction-curette, and if among the diffluent lens-matter and aqueous humour be found a solid nuclear portion of the lens remaining, the corneal opening should be enlarged with a knife for its removal with a scoop, if without one it will not escape. Of course, unless it follow an accidental wound, the lens should not be so much exposed by so extensive a laceration of its capsule as to admit of so much swelling that inflammation follows ; but this cannot always be calculated beforehand. In *first* operating in any case on an eye by the needle-operation, unless, perhaps, in infants and very young children, it is well not to make more than a small opening in the lens-capsule, for fear of this mechanical irritation and after inflammation ; also, I would not extensively at first break up the lens within this opening, or the consequent swelling may open out the whole lens, though the opening made in the capsule, by the needle, was not large. Within a week, even in the older patients, in any case, I think, the greatest amount of swelling consequent on needle-operation will be reached. After that, so long as the bulging lens-matter shows in the wound it may be left—the pupil being merely kept constantly dilated with atropine drops or belladonna lotion, whilst absorption is going on.

In a few weeks, more or less, the lens-matter, which was bulging, no longer protrudes ; the surface is perhaps rather flattened, and the situation of the opening made in the lens-capsule is somewhat excavated. The needle then should be used again ; and at the second or at least the third time of using it, after sufficient intervals, there is no fear of the remaining lens-matter swelling enough to bring about any inflammation, and it is much more unlikely now that a fragment of lens should be detached and so set up inflammation. Hence the needle may be used in the latter operations more and more freely each time. And the needle must be employed whenever the bulging out lens-matter no longer protrudes, and the wound in the lens-capsule seems to be a little excavated; for, if the repetition be long deferred, the lens-capsule in front may become so tough that it can never be thoroughly broken up, and it will be drawn in at the edges of the surgical wound, enclosing some portions of white opaque lens-matter which, if not in the centre so as to obstruct vision, will show when the pupil is large, and are a defect, in appearance, in the good result to be expected from timely interference. If the capsule be toughened, the lens will perhaps move about on the end of the needle as it is moved about, and the lens-capsule is no more torn open. A second needle must then be introduced from the opposite side of the cornea, and then with it the lens may be held and steadied while the needle in the other hand tears open in various directions the capsule, and breaks up the lens-substance freely; or, if it be very tough, the two needles, introduced from each side of the cornea, and meeting at the same aperture in the lens-capsule, may have their points separated, so as to make a large rent in it. The posterior capsule is throughout to be carefully preserved from any accidental wound. If it should be wounded, whilst the lens is still bulky and softened, and it let the vitreous body come forward and protrude in the midst of the lens-matter, the vitreous body pushes aside the fragments of broken up lens against the iris and ciliary processes, and mechanically sets up inflammation, which commonly ends badly. It is very difficult—if not impossible—to remove such fragments by the curette or the syringe, without injuring the vitreous body, which lies in the way; it will, however, be better to lose some vitreous humour than to leave much lens-matter pressing upon the iris, &c., if such a mishap should occur, and the fragments *can* be removed. In the *final* stage, however, of "solution" or keratonyxis (as the needle-operation has been called), very little of the lens being left, the carefully preserved *posterior* lens-capsule has not unfrequently to be purposely torn open, and a rent, through which the vitreous body protrudes, to be made; for small opaque fragments often remain upon this capsule, after most of the lens-matter has been removed little by little; or delicate grey webs and streaks and puckerings appear in or upon it, visible, perhaps, only by use of the oblique illumination, and yet interfering very much with good vision. There are now no fragments of lens that can be displaced and excite inflammation.

In old people, or even in adults, a needle-operation is a very tedious process. The lens-matter, though swollen, has irregular hard margins, and will very likely set up inflammation of the iris and ciliary processes, &c. A detached fragment of the hard senile cataract left after an extraction will be very likely to do the same; and elderly people, in any inflammation of the eye, are always more likely from their age to get a glaucomatous complication of the disease. But if a young adult have one useful eye, a cataract in the other may be got rid of by repeated use of the needle, doing each time very little with it; and the process, tedious as it is, is safe from the greater risks of extraction; and the inconvenience of the delay, in such a case, will not be felt. If in this process of solution there should in any case appear to be increased tension

(T. 1.) even though the pupil be fully dilated (atropine of course being used) and there be no ciliary redness, the swollen lens-matter must be at once evacuated, and perhaps an iridectomy upwards done at the same time.

**Suction-Operation.**—Fluid cataracts are sometimes, but not often, found; the whole contents of the lens-capsule being evacuated into the anterior chamber when the capsule is torn open with a needle. They occur, perhaps, in young adults for whom we should use the needle. They look like soft cataracts; and they can hardly or unfrequently be distinguished from ordinary soft cataracts, besides that from their rarity they are not expected. They appear of an uniform colour. Somewhat like them surgically are the cataracts of diabetic patients, though these latter are not fluid, only very soft; so that, after the needle has been used, although the patient be middle aged, the whole of the lens is mixed up in the aqueous humour, and can be, and indeed must be, removed forthwith. In this I am speaking of my own experience, in which I have had a succession of cases of diabetic cataract, all alike, and all successfully treated by suction, at one operation, as described below. I do not say that all diabetic cataracts must be like those to which I refer: they were of a bluish milky colour, very large, apparently pressing forwards the iris, with some broad, convergent, indistinctly glistening striæ anteriorly, rather lighter in colour than the body of the lens itself. The syringe is also available in the cases of wounds of the lens in children or young adults, in which, soon after the injury (or a first needle-operation), in a week or thereabouts, the whole lens is much swollen altogether, and in cases where, by a subsequent needle-operation, it has been completely broken up and has become uniformly swollen and diffluent. In the youngest patients, it is most probable that the natural process of absorption will suffice to effect the removal of the lens-matter without risk of inflammation. If it should be altogether very much swollen, even if there be no dangerous symptoms, it is well to hasten the cure by evacuating at least the major part of the soft cataract. Not unfrequently the wound in the cornea, through which the lens was wounded, will be the most convenient way of reaching the lens; and often, when a soft swollen lens-mass is pressing outwards the lips of the wound, the thin weak recent cicatrix retaining it may be easily traversed with the end of the suction-curette, and so it may be altogether removed without any cutting instrument. The operation is a very admirable one, and, if practised carefully in the above-mentioned cases, it deserves more consideration than it has obtained. Diffluent lenses used to be evacuated by the curette; a sufficiently large opening having been made with a broad needle, the curette was introduced into the anterior chamber, and a gush of the aqueous humour and lens-matter took place, and then, by various little movements to-and-fro, a little more of the lens-matter was made to flow along the groove of the instrument. Now, in such a case, by using the syringe, with the end like that of a curette, but made tubular, keeping the point of it in the posterior aqueous chamber, and the orifice being forwards, we can, without any movements endangering the iris, *suck out the whole of the diffluent lens-matter.* The corneal opening is made with a broad needle, which should be made to enter also the lens and lacerate the capsule, if necessary. It should be large enough easily to admit the suction-curette; and the point of this, when once introduced, should be brought into *the centre of the pupillary area,* and then carried back until it is *in contact with the posterior lens-capsule.* When there, the point *should not be moved about,* or it may draw in the iris, or afterwards the cornea, with the lens-matter, or bruise the iris. The patient being recumbent, and the point of the instrument kept well back in the posterior aqueous chamber, in the hollow of the posterior capsule, all the diffluent lens-matter will fall towards the orifice and be drawn in succession into the syringe. If, in a case of a swollen accidental or surgical traumatic cataract, the Surgeon cannot be sure that the lens-substance is completely dissolved in the aqueous humour, after a lapse of time amply sufficient according to the age of the patient (the older the patient, the slower is the cataract in becoming dissolved in the aqueous humour), it will be better to defer the use of the syringe until some evidence of irritation, redness in the ciliary region, &c., shows itself. In no case would it be necessary to wait more than a week or ten days: but, if the lens-matter be imperfectly dissolved, some fragments clog the small tube of the syringe, and then it is necessary to remove the instrument from the eye, and reverse the action so as to force out the fragment causing the obstruction in the tube of the syringe. This necessitates the introduction and reintroduction and various movements of the syringe, almost as much as used to be required with the old curette in the anterior chamber.

The suction-curette is invaluable, especially for the total removal of the whole lens at once, without any previous needle-operation on an earlier day, by a very small opening in the cornea, in diabetic and other quite exceptional cases of cataract; and next in those in which the preliminary operation (or an accidental wounding of the lens) has, after a little while, made it possible and desirable thus to remove the lens, or a great part of it, in a large number of cases; for, with the suction-curette, the corneal opening need be only very small, and the parts concerned little disturbed. The great amount of swelling of the cataractous lens-substance, and the evenness of its bluish-white tint, are, together with the history of the case and the age of the patient considered, the best indications that can be obtained of the practicability of a suction-operation; but if, in any case, the operation should prove to be impracticable, it has no way precluded a subsequent traction-operation with a larger opening in the cornea. It is also, in different cases, sometimes useful in other operations for cataract, in cases where the old-fashioned open curette would have been used, so as to employ suction-power instead of traction, &c. Whenever a cataract has been removed by flap-extraction or smaller corneal section, and soft cortical matter and shreds of lens-capsule remain, less injury to the parts is probably done by use of the suction-curette than by the old curette or other traction instrument; but the latter must be used in many cases when the cortical matter, &c., is not very soft, and the suction-curette becomes clogged. As to the shreds of lens-capsule and lens-matter involved, the grooved curette cannot possibly remove them, and considerable fragments of lens-matter cannot be removed with either the suction or the grooved curette so readily as with a scoop. The grooved curette acted best when, with the first gush of aqueous humour along its groove, the opportunity was taken to let pass along with the aqueous humour as much as possible of the diffluent lens. Now, with the suction-curette there is no voluntary gush along the tube of the instrument when it is introduced, only beside it, perhaps, and the space beside it is not large enough to let pass any but the smallest fragments that may come in the way ; so, not to lose the opportunity given by the natural force of expulsion and the greater quantity of fluid contents, we must begin to employ the suction-power as soon as possible after we have entered the suction-curette in the anterior chamber, or the aqueous humour without the lens-matter may be running to waste.

**Secondary Operations for Cataract.**—Opaque matters on the capsule of the lens, remaining after removal of cataract by any one of the various forementioned methods, very often necessitate a final operation ; without which, indeed, the promised good result of the operation—for there has been no iritis in these simple cases—is in abeyance. When it is plain that this little operation will be required, it should be done as soon as all redness, remaining after the primary and major operation, has disappeared from the eye ; for, if it be long deferred, the capsule becomes so tough that it cannot be torn through without much force, or the use of two needles, and even then, perhaps, a rent insufficiently large is made ; and, moreover, the force used, and the dragging made on the parts around, may light up an inflammation which will after all close the aperture made in the capsule. It is seldom indeed that, with a pupil widely dilated, one cannot see, after removal of the lens, some opaque patches and streaks left upon the posterior capsule *in situ* ; but these are very often only found in the margin, and there chiefly in most cases where they are generally distributed. Others consist of shrivelled-up remains of the anterior lens-capsule, and of traces of the cataract itself ; and yet, although these may be considerable, if they have been drawn away towards the circumference with the retracted capsule, as they are usually, all ways *behind the iris, when not under the influence of atropine,* they will require no needle-operation. If the central parts be clear, there would seem to be no obstruction to vision, and the patient should have good sight ; but, as in doubtful commencing cataract-cases, we have two methods of examination—the ophthalmoscopic mirror, and, if this fail to show us any opacity, or to explain otherwise why vision, with proper spectacles, is still imperfect, oblique illumination, by which, sometimes, such a puckering of the posterior capsule is detected as (without any opacity) to require an opening to be made in it with a needle. By the ordinary needle-operation for these secondary cases, when there is a central obstruction, the opacities are but thrust away and subsequently left to be drawn aside altogether, and permanently, by the shrivelling of the lacerated capsule, leaving thus the central part free and unobstructed.

The eye is fixed open and steadied by use of the wire speculum and toothed forceps ; or, if one needle only will be wanted to be used, the operator may employ the fingers of his left hand instead of both (see Fig. 566) ; then he passes into the anterior chamber, through some marginal part of the cornea, wherever it may be most convenient, and not very obliquely through the coats, a cataract-needle, the point of which is then brought down towards the capsule, and so far as to reach some way across it to the side opposite to that at which it has been entered : the capsule is then penetrated : and, without passing the instrument any further into the eye, the point is carried back, and towards the side at which it has been introduced. The needle should traverse imperceptibly the capsule, but it may have become tough, and offer some resistance ; or, in an old neglected case, although it may be perforated, it is so very tough and elastic that it cannot be torn, without the help of another needle entered on the opposite side of the cornea. And we may not merely regard the opening that is to be made without considering the force used : the operation must be done without any dragging upon the ciliary processes and surrounding parts, or iritis or even ophthalmitis may be set up in the eye.

Sometimes after cataract-operation, a fragment of opaque lens-matter, enveloped in capsule, remains in the pupil : as it is a deformity, but chiefly because it obstructs vision, it must be displaced or removed. With a needle it may be detached at the parts at which it is least firmly attached in the circumference, and then it may be pushed aside, and perhaps it will be retracted behind the iris, and remain out of sight, and, as regards the patient, offer no obstruction to vision : it does no harm and may be left there, but, if it remain very loose, sometimes or always appearing in the pupil, and interfering with vision; or if in the former needle-operation it seem to be but slightly connected with the surrounding parts, then it may be removed with iris or cannula forceps, introduced by a sufficient opening made in the margin of the cornea with a knife or a broad needle. This may only be done if its attachments be weak ; if they be strong, perhaps they can be cut through first of all with iris or cannula scissors, and the forceps then used. With iris-forceps and iris-scissors we have much more power and certainty than with the cannula instruments ; but for their use we must, of course, have a larger corneal opening. Sometimes, and not unfrequently, an opaque band or two are found behind the pupil, after cataract-operation, in the level of the posterior capsule ; if one of these be in the way of vision, it may, if recent and not thick, and if it cannot be broken through with a single needle, be twisted and broken by two needles introduced from opposite sides, or divided with scissors : then it will retract and remain out of sight. The twisting operation is somewhat dangerous, by reason of the dragging it may cause upon the ciliary processes, &c. Experience in this and in other eye-operations only will inform us how much force may be used ; but if the eye be otherwise useless, some operation must be done at all events, and I think in such cases probably it is best boldly to make a quarter section of the circumference of the cornea with a knife, then to introduce the points of a pair of iris-scissors, having one point blunt to be kept next the cornea, and the other sharp to be thrust within the pupil, behind the band, and so to divide it and leave it in two parts. The cannula instruments, forceps and scissors, are introduced by making for them, with a broad needle, a preliminary opening in the margin of the cornea, wherever it may be most convenient, not very obliquely, or in use they will bruise the cornea, and only just sufficiently large so as to retain as much as possible of the aqueous humour, and as large a space in the anterior chamber as may be for the use of the instruments.

In all the above cases, I have presumed that there are no considerable iritic adhesions, certainly not any occlusion of the pupil ; if either exist, it is probably best to make an iridectomy in the situation best adapted for an artificial pupil, and if by this, behind it, some remains of the cataract be exposed, to incise the membrane, or to divide it with scissors.

## EXTIRPATION OF THE EYEBALL.

If an eye be rendered useless, especially if it be in consequence of some former injury, it is probably best to remove it ; certainly if any irritation or inflammation exist in the other eye, or if it be unsightly, or if there be any foreign body remaining within it, or if the patient be one who cannot probably, at a future time, at once obtain good advice when sympathetic irritation may have arisen. In the latter case, that of the labouring man or of the needle-woman, the sight of the seeing eye will be secured ; and, then, even if the patient cannot afford an artificial eye for the future, the deformity of a vacant palpebral aperture is comparatively of very little importance. But if, when the least occasion may arise, the patient be in the way of good advice, and be duly convinced of the importance of not neglecting any trifling and transitory pains and obscurations in the sound eye, and the one lost be also in appearance an eye, it may be left. In some cases, that are not urgent, the value of appearances may turn the scale in determining whether or not to recommend extirpation. An eye should certainly be excised if it be blind and painful, or, if sympathetically without pain, the other eye be threatened in the least degree. The operation of excision is *urgently* called for, in cases of intraocular morbid growths, as soon as detected with the ophthalmoscope or otherwise ; when a foreign body is known to remain within the eye, and cannot be extracted from it, even if the eye be not quite blind, or but very little painful or tender at the time ; also at once, in cases of suppuration of the eye after ophthalmitis, or of hæmorrhage and clot filling the eye, at the time when an operation has been done. A lost, blind, and painful glaucomatous eye, or a glaucomatous eye that is blind and has been painful, should be removed ; for in the latter case it is useless, and the pain will return ; or, if iridectomy were to be done to prevent the recurrence of pain, it is a blind eye at all events, and rather unsightly. The probability of much pain to be experienced in a disorganised globe would decide the question in favour of the operation. And, whenever it is to be recommended, it must be strenuously urged ; and, if it be not adopted, the responsibility of the decision must be plainly made to rest with the patient. Sympathetic irritation in a blind eye affecting the other may be allayed ; but the sympathetic inflammation following the loss of an eye for practical purposes, by old injury or deep-seated inflammation, is one of the most terrible and intractable and destructive with which we are acquainted. And if it be subdued, it will recur : each time with some more impairment of vision afterwards. An eye totally blind will never see again. And, with a good artificial eye adapted, the deformity of the extirpation will not be much.

In this place it seems to be necessary to distinguish between blindness as the word is used by ophthalmologists—a want of perception of light—and blindness in the common acceptation of the term. By blindness is generally meant no more than a greater or less degree of want of useful vision, but real blindness of an eye is only to be diagnosed in some such way as the following. The palm of the Surgeon's hand is closely applied over the eye not in question, the patient being placed opposite to a noiseless gas-burner, or other very bright light, but not so near that the heat of the flame is appreciable; when questioned very many times, the patient, if blind, cannot rightly tell the flame from the absence of it, when it is turned down so low that no actual light remains. The patients have had the power of vision, they may be habitually truthful, but they are glad to deceive themselves unconsciously (we need not tell them so); they feel the warmth of the sun's rays, or of the fire, and, knowing what is the cause of this, they think that, as they used, they still perceive the accompanying light: they hear the shutters shut and the lamp set on the table, and they picture to themselves the light, and even the objects lit up by it, in their accustomed positions. Or, they *subjectively see* flashes of light which are symptomatic of their complaint, and are analogous to the light we see in the dark with our eyes shut when the eyelids are violently rubbed. They say they can find their way about, but then *it is in their own homes*. They say they can count fingers, and then they hold up their own to count. They are loth to believe that they really see nothing at all, and therefore it is that in all cases it is necessary rigidly to cross-examine every patient in whose case we have reason to suspect total blindness or the absence of any perception of light. A few questions will be only misleading, and every such case must be treated as if we suspected the patient of *malingering*, as it is called by army Surgeons.

**The Operation** is thus done. When the patient is under the influence of an anæsthetic, a (spring) wire speculum is inserted between the lids to keep them open; the conjunctiva is seized with toothed forceps, at any part near the margin of the cornea, and a small opening is made in it with rather blunt-pointed scissors. In the next place, the conjunctiva is to be divided all around the cornea. This may be done by inserting one blade of the scissors beneath the conjunctiva where it has been opened, and drawing the globe with the forceps one way or the other, as may be most convenient; or by seizing the conjunctiva with the forceps at the part to be next cut through, if it be too closely adherent to the subjacent parts to allow the passage of the point of the scissors. Or the strabismus-hook (Fig. 564, *d*), inserted at the opening made in the conjunctiva, may be carried round the cornea, and the conjunctiva, raised a little in this way, may be conveniently cut through if it be loose. When the circular incision of the mucous membrane is completed, the subconjunctival tissues, seized at different parts in the wound, are cut through with the scissors, the points being directed backwards and kept as closely as possible to the globe. An opening still deeper, close to the globe, in some part of the circumference of the wound, is made with the scissors, and then the strabismus-hook is passed beneath the tendon of one or other of the rectus muscles, which is divided, and so are then the other tendons in succession and other intervening parts close to and connected with the globe. The tendons of the oblique muscles being directed to the temporal side to be inserted, the hook must be directed towards and kept very close to the globe to secure them. But only the four rectus muscles are generally worth a separate search. All the tendons being cut through, the divided ocular insertion of the internal rectus is seized with the forceps and the eye drawn outwards; a pair of scissors curved on the flat (Fig. 564, *e*) is carried down beside the globe on the nasal side, as, on this side, the optic nerve enters the globe and is most easily reached; the scissors are opened a little and advanced, and the nerve is at one stroke divided.

The globe now generally comes forward suddenly. It is drawn forward by holding it at the point of insertion of one of the rectus muscles or wherever it may be secured conveniently, and any remaining adherent soft parts are divided, always of course as before, close to the globe. Dixon finds it convenient to leave the insertion of the internal rectus muscle to be at last divided after all the other muscles have been cut through, and the optic nerve also. Sometimes, if the globe be staphylomatous or enlarged, so that after the division of the rectus tendons it is difficult to reach further back with two instruments within the comparatively small palpebral aperture, it is convenient then to remove the spring-speculum, and with the points of the fingers within the two lids to force them backwards, so that the eye comes to stand out in front of the lids ; and this being done, the optic nerve may be easily reached with the scissors and divided, and the remaining soft parts dissected from the globe. Or it may even be necessary to enlarge the palpebral aperture at the outer canthus, or to evacuate some of the fluid contents of the eye. After the four rectus tendons have been divided in this operation, the removal of the globe should be completed as quickly as may be, to prevent loss of blood, or its being extensively effused in the orbital and palpebral areolar tissue ; for, if the latter take place, it is so much the more difficult to reach the deeper surrounding parts to divide them, and the wound is longer in healing, and the lids of the patient are for so much the longer time discoloured afterwards. Hence we must stop the bleeding as soon as possible after the globe is removed from the orbit. The most effectual way is, perhaps, the speculum being still within the lids, or reintroduced, to have a basin of cold water brought, and a sponge full of it held at some height, so that the water falls from it in a continuous stream and with some force into the vacant orbital space, a large empty sponge being also placed against the temple of the side of the extirpation to receive the flow of water. It should be continued until the oozing of blood from between the lids has ceased. Then a small round empty sponge, compressed to make it go between the lids and a little way into the orbital space, is placed there, and confined very closely with a bit of cotton bandage, tied tightly round the head, the knot over the sponge, and this should be left so for six hours. It then may be removed, and simple water-dressings applied until the wound is healed. When this is complete, if a glass eye is to be worn, it should be adapted at once ; or one of small size should be at first introduced ; for after a time the lids, left unsupported, will not contain one of full size, and the parts will less rapidly accommodate themselves to the new state of things, the puncta are misplaced, and the lashes inverted and a source of irritation. The soft parts, including the muscles that surround the eye removed, now inserted into a central mass of hard cicatricial tissue, will form a cushion on which the artificial eye rests, and some little power of motion will thus be given to it ;—less, of course, than after the operation, next to be described, of *abscission*, or than in those cases in which, generally in former times, an artificial eye was employed, those, namely, in which the stump of an eye, lost accidentally or by the ill-result of some surgical operation, was left and was suffered to remain behind the lids. The cicatrix in the conjunctiva, after an excision, is generally cruciform : an indication of the four different points at which the tendons of the four rectus muscles are left and have drawn in a little the mucous membrane. In the centre sometimes is found a button-like projection of some of the soft parts left outside the mucous membrane in the healing of the scar, and constricted by it to a narrow neck in the centre behind the projection. It is easily snipped off with a pair of curved scissors. Less deformity or greater perfection in simulating the appearance and movements of a lost eye may be, no doubt, obtained by abscission; but it is generally a short-sighted policy, and very often as dangerous in the end, though brilliant at the time, as was the old operation of *couching* for cataract.

There is but one serious mishap after an excision-operation; and that is, continued bleeding from the deep-seated soft parts many hours after the operation. It arises from parts inaccessible from their being far back in the orbit, and so much the more so when the areolar tissue of the orbit and lids is distended with blood: these become so tense and prominent, and pressure is so difficult of application in the midst of so much infiltrated areolar tissue and fat, even if one knew exactly whence the bleeding came, that it is difficult to overcome it when it occurs. It has never but once occurred to me since I have used the cold water as above described, and the sponge and tight bandage subsequently to this, after the operation. In a previous case, very early in my practice, where perhaps in doing the operation I had not merely divided the parts close to the globe of the eye, I was called to the patient in the night after I had operated. The lids formed two enormous red protrusions, and a little stream of blood flowed continuously from between them: I tried the actual cautery ineffectually, and succeeded at last by thrusting long pointed rolls of linen soaked in tincture of perchloride of iron, in different directions, into the spongy mass.

It can never be worth while to do the operation of abscission in any case, otherwise favourable for the operation, unless the patient intend to wear a glass eye; if he do not, the globe had certainly better be excised at once: and in such case, an operation has sometimes been done to create a permanent artificial ptosis, by removal of a part of the levator palpebræ muscle near its insertion into the cartilage of the upper lid, by an incision through the skin, just below the upper edge of the orbit; the lid then falls, and the vacant space is always covered by it. If, instead of carefully preserving the conjunctiva, as in cases of excision of the eye in which an artificial eye is to be worn, it be all removed, the lids will be evenly and permanently closed, and this I have done in some such cases.

As to the old operation for extirpation of the globe, in which a great part of all of the surrounding contents of the orbit were, with it, removed with a large knife, it is never necessary, and therefore it is never done by able Surgeons, except in cases in which a malignant or other growth has penetrated the coats of the eye from within, and extended more or less into the soft parts around. Then these parts must be widely cut away, when the globe is excised, with a knife or scissors, as may be most convenient.

Abscission.—A few years ago this operation was much more in use than it now is. It is applicable to cases in which there is no essential pain, in which the disease, *staphyloma corneæ* generally, is confined to the front of the globe, so that by this operation, at least probably and mainly, all the parts diseased may be removed.

**Staphyloma** is a term applied to any bulging of a part of the coats of the eyeball, primarily of the sclerotic or cornea, or of any tissues replacing these proper coats. Staphyloma corneæ generally begins at a part at which there is a scar, the cicatricial tissues being, if not thinner, at least less capable of resisting intraocular pressure, whether of the normal amount or in excess. The staphylomatous parts may have been merely weakened by old inflammation, without any breach of surface; or actual loss of substance may have been replaced by imperfect tissues that give way, if not at once, with very little provocation. A sclerotic staphyloma will involve the other coats within it, which also become expanded and thinned. A corneal staphyloma frequently carries with it the iris, which had become adherent to the posterior surface of the cornea, when the disease, the first cause of the staphyloma, brought them into contact, and thus it is expanded over the bulged cornea behind it. A corneal staphyloma generally has a central white patch, ill defined in the comparatively clear tissues around it, the leucoma marking the old disease in which it had begun. A small partial corneal staphyloma, in a seeing eye, may be, if sufficiently well defined, simply removed with a knife, leaving the remaining clear cornea, in the hope that it will firmly cicatrise, and not again bulge, and afford still useful vision; but such a case is not often met with, nor is the hope then often fulfilled. If an eye with total but inconsiderable staphyloma corneæ retain some vision, one can only do abscission or excision, if the patient decidedly wish it; then it may be done because it will only go on from bad to worse, and at a future time the operation will be inevitable. But in a case of extreme corneal staphyloma, the eye, very probably, still retains perception of light; and of this, unless it be *all* the patient sees, the other eye being lost, no account must be taken, and the operation must be recommended.

Pain alone does not contra-indicate the operation of abscission, but it must be apparently such as is due only to the disease of the anterior parts of the eye, to the irregular surface and prominence of the quasi-corneal tissue, sometimes even exposed for some time to the air, and drying, as the lids can hardly close over it.

The object of the operation is to remove an useless and painful or unsightly feature, and to gain, instead of it, a low stump as a good foundation for an artificial eye. If we are careful to remove the lens, which is liable to chalky and other degenerations, and the ciliary body, which is full of muscular tissue, nerves, and blood-vessels, together with the offending parts, we get rid of future sources of offence, and very much lessen the chances of irritation and inflammation in it, and of sympathetic irritation and inflammation in the other eye.

But there are many cases in which abscission or excision, one or the other, is called for; and in these cases, generally, excision is undoubtedly advisable. In the cases of great staphyloma corneæ, the deeper parts are only comparatively sound, and, even if they were quite sound, after abscission, the stump made by the operation, though one is very careful to remove the ciliary body and lens, does not seem practically to be very unlike some of the accidentally wounded and shrunken globes that always must be excised whenever the cases occur. The cases of corneal staphyloma are generally those of young persons, to whom personal appearance is more important than to those more advanced in years. If it were not so, the excision operation would be more generally adopted in cases of disease of the front only of the eye. The stump of an eye left, if it can be made useful, is a much better foundation for an artificial eye to be worn upon, than is the cushion only of the soft parts left far back in the orbit by excision; and the ocular muscles have a definite insertion and action. The healing of an abscissed globe is tedious, and perhaps painful; whereas there is no trouble or anxiety whatever about the healing after the excision of an eye. But few comparatively of our *hospital* patients will or can have the opportunity in future years of continuing to provide themselves with an artificial eye, every year or two, when a new one is required. And it is absurd to do an abscission in any case unless the patient intended to wear a glass eye; he had much better have the offending globe removed at once and altogether, if for that reason only. In private practice we can better depend on our patients not neglecting any symptoms against which they are warned; and, of course, the stump of an abscissed globe can be excised at any time if it began to be painful or tender.

*Operation.*—An incision, oval horizontally, through the sclerotic and other coats of the eye, is made to enclose the cornea, ciliary body, and lens, all of which are removed together. Sutures may or may not be used to draw the sides of the gap together, from above and below, to retain better the vitreous body, to hasten the time of healing, and leave a better shaped stump and smaller scar. But the sutures sometimes give much pain, and keep up inflammatory symptoms during the protracted healing. Supposing they are employed, three or four stout and semicircular curved needles, each with a silver-wire or black silk thread, are inserted in a row above the cornea, at about half an inch from the corneal margin. These are respectively carried at some distance behind the ciliary body and lens, and brought out below the cornea at about as far from the corneal margin as they were when introduced. Then a puncture is made with a pointed knife through the coats of the eye at about half an inch external to the margin of the cornea, and by it one blade of a blunt-pointed scissors is introduced, and so an oval piece of sclerotic, including the cornea, &c., is removed altogether, and just within the points at which, above and below, the needles traverse the sclerotic. Then the needles are drawn through, and the sutures are tied in knots each to each.

## THE OPHTHALMOSCOPE.

The advantages of the ophthalmoscope, in a surgical point of view, and as an aid in the treatment of eye-diseases generally, have been alluded to (p. 413, *et seq.*).

Fig. 573 represents the way in which I recommend the instrument to be used. The patient rests and steadies his head against a high upright-backed chair. (*Ophthalmic Hospital Reports*, vol. III. p. 64), and the observer, standing before him, can easily move his head, not only from side to side, as when he is seated in the way usually recommended, but he can as easily look from above or below; and this is more convenient, as he can more easily command his own movements than those of the patient's eyes. The best common ophthalmoscope is Liebreich's. It has a small, polished, slightly concave metal mirror, reflecting enough light, but less, of course, than a silvered glass mirror, which moreover is usually made larger. The silver plate has a rather small central aperture, which is well defined as compared with that bored through the thickness of the glass plate or scraped in its silvering. The mirror is framed and backed in thin brass, painted black. A short black handle is appended, and to one side of the frame is a clip, to hold behind the hole in the instrument one of various small lenses, which are supplied with the ophthalmoscope. This clip is hinged, so that the lens contained by it can be turned aside when it is not required to be used. The mirror is held, as in the figure, to the right eye, to examine the right eye of the patient, and *vice versâ*, with the handle horizontal, the little finger extended for the patient to look at, which if he does, then the observer (unless also the eye that is being examined be squinting) has in view the optic nerve-entrance in the fundus of the eye. And this is the best starting point, although the rest of the deeper parts of the eye remain to be examined. It is best to begin the use of the ophthalmoscope in the normal eye (the pupil dilated with atropine) of a young person of fair complexion. First, a reddish glare is seen, and this is lighter at the optic nerve-entrance. Then, in order to perceive the details of the fundus, the lens, held in the free hand of the observer, is brought before the eye that is examined at a distance of a few inches, and moved all ways in the line of the reflected light of the fundus, until the best image is obtained. This hand may be steadied against the forehead of the patient. This mode of ophthalmoscopic examination is the "indirect" (inverted image). It is that usually employed. Some practice with the ophthalmoscope is necessary before proceeding to examine

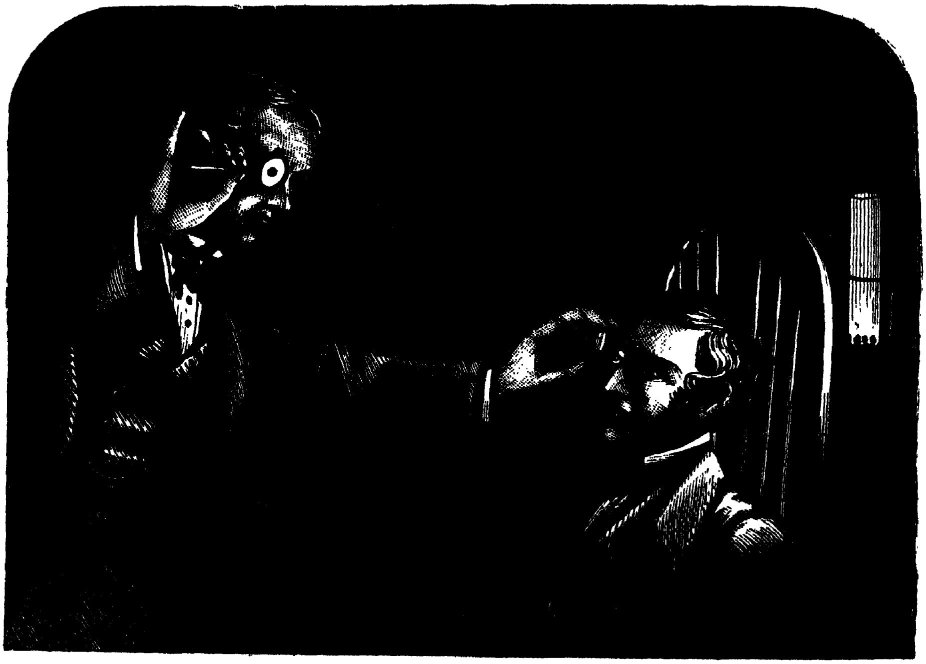

Fig. 573.—Use of the Ophthalmoscope.

the deep-seated morbid appearances within the eye. The preliminary use of atropine should be dispensed with as soon as possible in learning the use of the ophthalmoscope, and always afterwards, when the diagnosis without it is not made incomplete. Or at least it may be employed in weak solution, for one eye only (that of which the patient is independent—the worst eye—the least useful), and the patient forewarned of its temporary effects. Waiting for the pupil to become dilated expends time, and if atropine be indiscriminately used the increasing mischief, in some cases of nerve-blindness, &c., will be often ascribed to it. And for ophthalmoscopic diagnosis, it is only absolutely required in some obscure cases of commencing cataract or of vitreous and other opacities in the fundus oculi, &c.

With the ophthalmoscope, a lens or cataract dislocated by a blow into the vitreous chamber, and lying quietly at the bottom of that space, or gravitating perhaps to either side, may often be detected. Operation follows, of course, in this case the diagnosis afforded by the ophthalmoscope, which without it certainly would be impossible: an attempt at least must be made to remove the lens "couched" thus accidentally, in anticipation of the irritation and inflammation that it will set up. Dixon (*Ophthalmic Hospital Reports,* vol. I. pp. 280-5) reports a case in which he discovered by the use of the ophthalmoscope, in the ordinary way, a foreign body (a chip of metal) entangled in some remains of blood-clot hanging in the vitreous chamber. Thus aided, and having perfectly satisfied himself of the exact position of the foreign body, he made an opening through the sclerotic at a point opposite to that at which it was suspended, and succeeded in removing it with forceps. Also it is indispensable, previously, in desperate operations for evacuating the fluid of detached retina. Bader uses it, indeed, whilst he is actually operating. That is to say, he passes a long needle in through the sclerotic, &c., at a point opposite to the most prominent part of the detached retina, and, looking through the ophthalmoscope, he makes the needle enter this prominence; then he gives to an assistant the ophthalmoscope, to direct the light into the eye; he then passes a second similar needle, also through the sclerotic, at a third of an inch from the first, and, not passing it further in than the first, he directs it to the same spot, so that it may also enter the detached retina; and he makes them touch. Finally, by approximating the handles, without any other change of position of the two needles, he makes the rent in the retina. To be sure that this is done, he withdraws now the second needle, and examines the fundus again with the ophthalmoscope himself, to see if the subretinal fluid has entered the vitreous chamber, to see the rent if possible, or some evidence of the success of the operation. If there be none, he re-introduces the second needle, to repeat the operation.

# CHAPTER LVII.

## DISEASES OF THE JAWS AND THEIR APPENDAGES.

### DISEASES OF THE GUMS AND ALVEOLAR PROCESSES.

**Abscess of the Gums** is of very frequent occurrence, from the irritation of decayed teeth. Here a free and early incision should be made; which, by giving exit to the pus, will afford immediate relief.

**Spongy and Sloughy Ulceration of the Gums** will occur as the result of constitutional cachexy induced in any way—by mercury, malaria, syphilis, &c. It is best treated by tonics, in conjunction with the chlorate of potass and mineral acids internally. If it spread actively, escharotics, such as hydrochloric acid or creasote, may be advantageously applied. If it do not make much progress, a solution of nitrate of silver, with chlorinated or tannin gargles, will be useful.

**Simple Hypertrophy of the Gums,** in the form of a pendulous fringed outgrowth overlapping the teeth in back and front, is occasionally met with in young children. Such a growth requires to be freely removed with scalpel or scissors. In a case of this kind under my care, it was found to consist of the ordinary structure of the gums, with a fine fibrous stroma containing much gland-tissue; the papillæ on the surface were very large, and covered by unusually thick epithelium.

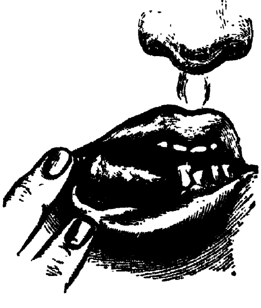

Fig. 574.—Epulis of Lower Jaw.

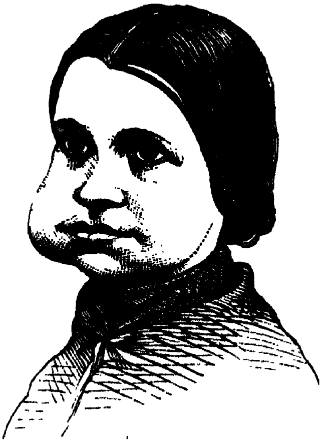

Fig. 575.—Epulis of Upper Jaw, hanging down so as to overlap the Lower Jaw.

**Epulis** is a tumour springing from the periosteum and edge of the alveolus, and implicating the osseous walls; it grows up between and loosens the neighbouring teeth, which it displaces and envelopes in its structure. It is of two kinds; *simple* and *malignant.* The *Simple Epulis* is a fibrous tumour; the *Malignant* is usually myeloid—if the term "malignant" can be applied to that form of tumour; but it is also occasionally cancerous.

Epulis is most frequently met with in the lower jaw (Fig. 574). I have, however, seen several instances of its springing from the alveolus of the upper jaw (Fig. 575). It appears chiefly to be occasioned by the irritation of decayed stumps, and hence occurs more frequently in connection with the molar than with the incisor teeth. Although this disease has occasionally been seen in children, it seldom occurs before the adult age, and then may be developed at any—even up to an advanced—period of life. It is seen then as often among females as males. A fibrous epulis appears as a red, smooth, and lobulated tumour, at first hard and semi-elastic, like the ordinary structure of the gum, but after a time softening by disintegration, and ulcerating on the surface, with a purulent or sanious discharge. The fibrous variety appears simply to be a circumscribed and rapidly growing hypertrophy of the gum.

*Treatment.*—The treatment of epulis consists in the removal of the whole of the mass and of that portion of the alveolus from which it springs. As it evinces a great tendency to reproduction, it must not simply be shaved off the bones, but a portion of the osseous structure must be removed as well; unless this be done, the growth will to a certainty be reproduced. In all ordinary cases of simple epulis, the removal may be done from the inside of the mouth without the necessity of making any incisions through the cheek. In very large masses of epulis, more particularly of the myeloid variety, and extending towards the ramus, it may be necessary either to carry an incision from the angle of the mouth downwards and outwards, or to dissect up the cheek from the bone, and thus expose the disease fully. In performing the operation, the first thing to be done is to extract a tooth on each side of the tumour; a cut must then be made with a saw through the alveoli of the teeth that have been removed, down to a level with the base of the growth. In doing this, care must be taken not to cut too near the remaining teeth, lest the alveoli be opened and their support lost. If the tumour be large, it may be necessary to saw deeply; but the base of the lower jaw should, whenever practicable, be left intact, the whole of its substance not being sawn through, so that, though a considerable portion of bone be removed, yet the length of the jaw may be preserved. For this purpose Hey's saw should not be used, as it is a niggling instrument, difficult to manage in this situation; but a straight and stiff-backed saw, with as deep a blade as the mouth will conveniently admit, will be found most useful (Fig. 415). The epulis, included between two vertical cuts, may now, if small, be removed with cross-cutting forceps, and the bleeding stopped by placing a plug in the wound and compressing it against the teeth of the upper jaw by means of a bandage passed under the chin. If the epulis be large, a horizontal cut should be made along the bone about midway between the alveolus and the base, by means of Hey's saw; and, after the bone has been penetrated to a sufficient depth, the blade of the cross-cutting forceps may be fixed in this cut, and the diseased part then removed. Should there be a spouting dental artery, it may be necessary to apply a red-hot wire, or the perchloride of iron, in order to arrest its bleeding. The cut surface will speedily granulate; and the cavity fills up with fibrous tissue. The operation for the removal of epulis is a very safe one. Of 28 cases collected by Hutchinson from different London Hospitals, only one was fatal, from pyæmia.

**Malignant Epulis.**—Cancerous ulcers and fungus sarcomatous growths from the alveolar processes, *malignant epulis*, as they are called, occur in the same way as the last; but they are soft, purplish, very vascular, grow rapidly, and are speedily reproduced after removal: they principally, so far as my observation goes, occur in males advanced in life. These tumours require the same operation as the simple epulis; and, as much hæmorrhage usually follows their removal, a red-hot iron must be applied to the bleeding surface. If a malignant epulis be very large, it may be necessary to remove a portion of the whole thickness of the bone, through an external incision, as will be described in the section on Excision of the Lower Jaw (p. 486).

**Necrosis of the Jaw** is commonly the effect of blows, of salivation by mercury, of syphilis, of fever, or of exposure to the fumes of phosphorus. I have, however, seen the disease occur idiopathically in otherwise healthy subjects, without any assignable cause. In this way I have seen the whole of the alveolar process of the upper jaw exfoliate in a young lady, otherwise perfectly healthy; and I have several times had occasion to remove large portions of the lower jaw—in one case more than half of the bone—for necrosis that could not be referred to any of the causes mentioned above, or indeed to any assignable reason. The disease begins with deeply seated pain resembling inveterate toothache, which nothing will allay; the gums become swollen; the teeth are loosened, and eventually drop out. Before they do so, however, pus usually wells up through the alveoli. Abscesses form inside the mouth and under the angles of the jaw, having fistulous openings through which bare bone is reached by the probe. The general health suffers greatly, more so than in necrosis generally, doubtless in consequence of the patient swallowing some of the pus from the dead bone.

Necrosis of the jaws, arising from the inhalations of the fumes of phosphorus during the manufacture of lucifer matches, first noticed by Lorinser of Vienna has been especially described by Von Bibra and Geist, who had abundant opportunities of observing the disease at the large manufactories at Nuremberg. This **Lucifer match disease** was some years ago very frequent, but, in consequence of the adoption of precautionary measures, is now much more rarely met with. It consists in necrosis of the jaws, and is attended by the symptoms above described, but in a more severe degree and an acute form. The affected bone undergoes a remarkable change, assuming the porous aspect and grey colour of dirty pumice stone. Both jaws are equally liable to be affected; but commonly one only at a time is diseased, and the whole of the bone may die and be separated. Thus of 51 cases observed by Von Bibra, both jaws were affected in five instances only—the upper alone in 21 cases, the lower in 25. According to Langenbeck, the local disease is preceded in many instances by general symptoms of phosphorus-poisoning; and there is a considerable amount of bony deposit from periostitis, which encloses the necrosed bone. It has been believed that workmen having sound teeth are not easily if at all influenced by the fumes, and that the phosphorus acts through carious teeth: but Langenbeck has observed that the teeth have been sound in cases of the disease.

*Treatment.*—The treatment of necrosis of the jaws presents nothing special. The removal of the sequestra should be effected as far as practicable through the interior of the mouth, by free incisions through the gums.

In the *upper* jaw, where the necrosis seldom extends beyond the alveolar border or the palatal process, this may always readily be done.

In the *lower* jaw, the question as to whether the dead bone should be extracted through the inside of the mouth, or by incision from without through the cheek, will be determined partly by the position of the sinuses and partly by the situation and extent of the bone affected. This may in a great measure be ascertained by the situation of the sinuses leading down to it. If these be in the cheek, or in the side of the neck, or under the angle of the jaw, it is usually an indication that, if the whole of the corresponding ramus or body of the bone be not involved, the posterior and outer parts are certainly affected; and, in these circumstances, extraction of the sequestrum is best effected by opening up the sinuses parallel to the line of the jaw, and removing the necrosed bone in the usual way. The incisions for this purpose need not usually be very extensive. If the operation be delayed, in accordance with those principles that guide us in the management of necrosed bone generally, until the sequestrum is quite loose, it may usually be readily extracted, in whole or in pieces, through an opening that will leave but a small cicatrix. By such operations as these, the whole of the lower jaw has been extracted piecemeal at intervals in a state of necrosis, first on one and then on the other side. Carnochan has removed the whole of the necrosed lower jaw at one operation, disarticulating first one and then the other condyle in the usual way.

If, however, there be no external abscess or sinus—if the gum have been loosened and perforated, with a ragged portion of sequestrum projecting through it into the cavity of the mouth, then no external incisions will be required, but the dead bone may be readily removed from within the mouth. Large portions of the jaw may thus be removed. I have taken away the whole of the ramus with its processes, entirely through the gums, without any external incision: and, in a negro, the whole of the bone in a state of necrosis has thus been removed in separate pieces, by Perry, through the inside of the mouth.

*Reproduction of the Jaw after Removal.*—The amount of regeneration of bone will depend greatly upon the state of the periosteum before the removal of the sequestra. If this be healthy, and if new bone have already formed prior to operation, a very perfect reproduction of the portions of jaw removed may take place; in fact, complete reproduction of the whole of the lower jaw, body, rami, and epiphyses, though in a somewhat rudimentary and imperfect form, may follow its removal for phosphorus-necrosis. In the museum of the Bellevue Hospital, New York, Wood showed me two specimens, one of the necrosed lower jaw, removed by him for phosphorus-disease from a girl about 19 (Fig. 576). She died of brain-disease three years after operation; and in the same collection is her cranium with a reproduced

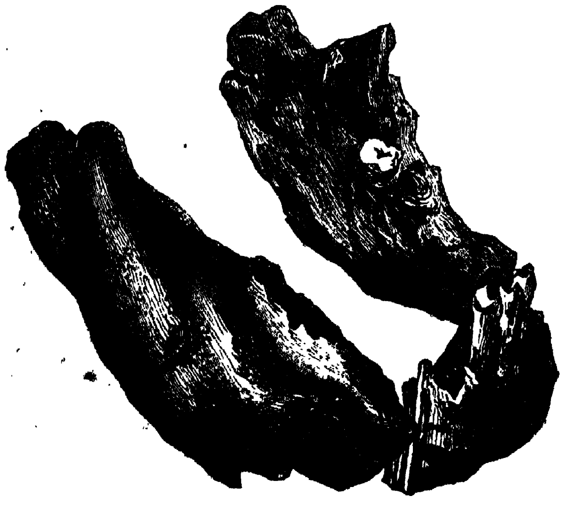
Fig. 576.—Wood's Case of Phosphorus-Necrosis of entire Lower Jaw.

lower jaw, consisting of an entire semicircle of bone, about 5-8ths of an inch broad, with all the epiphyses. This unique and most interesting case has already been described, and the regenerated bone figured (p. 182, Fig. 413). In it the periosteum must have been preserved entire, and thus led to the reproduction of the bone. Should no new bone have formed before the operation, a dense fibroid cicatricial structure will replace the removed bone.

### DISEASES OF THE ANTRUM AND UPPER JAW.

Our present knowledge of the operative procedures necessary for the removal of diseases of the jaws, is chiefly due to the labours of Gensoul, of Lizars, and of Liston. Sir W. Fergusson has greatly distinguished himself in this field of surgery, and has simplified and extended it much in its operative department; and C. Heath has made important contributions to its literature. O'Shaughnessy also, who has had many opportunities of witnessing these affections amongst the natives of India, has added much to our acquaintance with their pathology and treatment.

The various large and irregular cavities that lie amongst the bones of the face may become the seat of disease, primarily originating either in the mucous membrane by which they are lined, or in the osseous structures that compose their walls. In this way the frontal sinuses, the ethmoidal and sphenoidal cells, and the antrum, may either be seats of chronic inflammation of their mucous linings, with more or less profuse muco-purulent discharge; or the mucous membrane may take on more serious organic disease. Thus epitheliomatous, fibroid, fibro-plastic, myeloid, or cancerous tumours may develop from it, and, after distending the cavity in which they were originally formed, may thin and destroy its osseous walls; and, thus passing outwards into other situations about the face and the base of the skull, where they are freed from the pressure of surrounding bone, they may take upon themselves greatly increased development, blocking up mucous canals, as the nose and the lacrymal sac and ducts, displacing the eye, and producing great disfigurement of the side of the face. These secondary developments, from the rapidity of their unrestrained growth, and the amount of deformity and distress which they occasion, may readily be mistaken for the primary disease, the real starting point of which will often be found in a deeper and more limited locality. That the bones constituting the walls of these facial cavities may also become the original seats of morbid deposits, more particularly of the enchondromatous, myeloid, and encephaloid kinds, there can be little doubt. These deposits run a similar course to those originating in the mucous membranes.

**Dropsy and Cystic Disease of the Antrum**, from accumulation or rather development within this cavity of glairy mucus, like the contents of a ranula or ganglion, or of a thin brownish serous fluid containing cholesterine, occasionally occur. But in most instances the accumulation of fluid is serous and not mucoid, and the disease is evidently a true cystic development, with an active growth independent of distention. In some cases, distention of the antrum appears to be simply the result of the accumulation of its natural secretion; for, as the aperture leading from this cavity into the nose is a little above its floor, there may be a natural tendency for the fluid secreted here to accumulate to some extent before it is discharged; and if this aperture be from any cause blocked up, the secretion may increase to so great a degree as to occasion serious inconvenience by its outward pressure. In such cases the accumulation of fluid may after a time expand and absorb the osseous walls of the cavity, so as to constitute a true cystic disease ; and in this way the cheek is rendered round and prominent—an indolent semi-elastic tumour forming in it and protruding it outwards, and giving rise to the egg-shell or parchment-like crackling on pressure (Fig. 577). The floor of the orbit or the roof of the mouth may be caused to bulge, and the nasal cavity may be encroached upon.

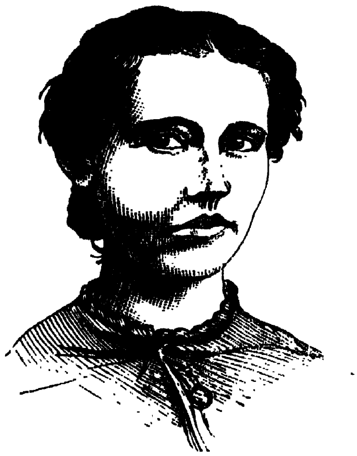

Fig. 577.—Cystic Tumour of Antrum.

According to C. Heath, we find that **Dentigerous Cysts** may occur in either jaw. They arise in connection with teeth which from some cause have been retained in the jaw. They are almost invariably connected with the permanent teeth. Tomes believes that they arise from the excessive formation around a retained tooth of a fluid which is normally found after the complete development of the enamel, between it and the soft tissues investing it. The tooth is not unfrequently found to be inverted. The cysts may occur at any age, but are most common in young adults. In the upper jaw they may form cysts in the antrum. In the lower jaw, they form prominent isolated tumours. They have been mistaken for solid tumours, and the jaw has in consequence been partially removed. Occasionally they may suppurate. Heath also mentions *dentinal tumours, i.e.* irregular masses of dentine growing from a tooth and forming tumours of the jaw ; but they seem very rare.

*Treatment.*—When the accumulation of fluid is small, with moderate expansion of the superior maxilla, catheterism of the antrum may be practised by passing a curved probe along the side of the nostril between the superior and middle turbinate bones ; where, in the middle meatus, about its centre, the aperture leading into the sinus may be felt. Should this treatment not succeed, or should the anterior wall be much expanded, the antrum must be opened from without : this is done without incising the lips or wounding the face, by thrusting a trochar and cannula into the most thinned and expanded part of the tumour under the cheek ; or, if necessary, by dissecting up the cheek from the gum, and thus making an opening into the cavity of the antrum with a strong pair of scissors or a perforator, through its most expanded and thinnest part, so as to allow the discharge to escape freely. In order to prevent a re-accumulation of the fluid, it will be better to cut away a small portion of the thinned and expanded wall of the antrum, and thus to establish a permanent aperture in it. The shape of the cheek may be restored by the gradual pressure of a spring pad or double-headed roller.

**Suppuration** may take place in the antrum. It is usually excited by the irritation of a carious molar tooth, or by some injury of the face, and may occasion much throbbing or lancinating pain. The pus, as it forms, will sometimes overflow, as it were, into the nose through the aperture into the middle fossa, and then may keep up constant irritation, with much fetor in the nostrils; in other cases, it drains through the socket of a tooth into the mouth; and in other instances again, its exit being prevented, it gives rise to enlargement of the cheek, the soft parts of which become brawny and inflamed, and the bones expanded, so that at last they are thinned to such an extent that, as in dropsy of the cavity, they crackle when pressed upon. Any portion of the wall of the cavity—the orbital, buccal, palatal, or nasal—may thus be expanded and fluctuation be felt through it; and, the lacrymal duct being commonly obstructed, the eye on the affected side becomes watery.

*Treatment.*—The treatment of this condition consists in the extraction of any carious tooth seated in the neighbourhood of the antrum; or, if the teeth be all sound, in the removal of the second molar, the fangs of which come into close relation to, and frequently perforate the bottom of, the cavity. In this way an exit may be given to the matter; but as it will not discharge itself sufficiently freely, the antrum must be opened through the alveolus, or through the canine fossa under the cheek, provided it be much expanded in this situation, so that its cavity can be easily reached. The perforation into the antrum may readily be made, or the socket of the tooth enlarged, by means of one of the forms of antrum-perforator here represented (Figs. 578, 579, 580), or a carpenter's gimlet, as recommended by Fergusson. As the matter drains away, the cavity will gradually contract, and the deformity thus be removed. It is well not to attempt to perforate in the site of teeth that have been extracted for some time, as here the bone becomes unduly consolidated, and the attempt to reach the cavity is consequently likely to fail. The matter that is discharged is often very offensive, or it may be thick and pasty from the absorption of its watery parts. After the aperture has been made, the

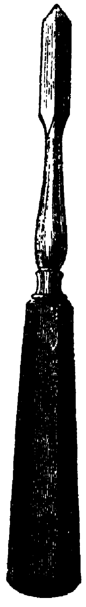

Fig. 578.

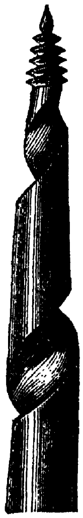

Fig. 579.

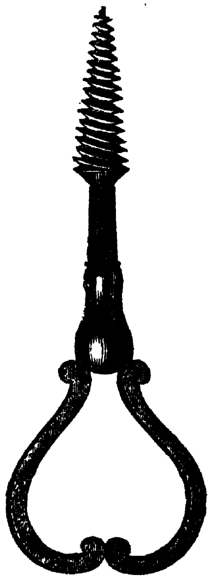

Fig. 580.

Various forms of Antrum-Perforator.

cavity should be syringed out with tepid water, and the shape of the cheek gradually restored by pressure.

**Tumours** of various kinds spring from the upper jaw, taking their origin either from the surface of the superior maxillary or malar bones, from the interior of the antrum, or from the pterygo-maxillary fossa.

Those that grow from the *Surface of the Bone*, are either some of the various forms of **Epulis** that spring from its alveolar border, and must be treated as already described ; or they are **Exostoses** growing from the outer surface of the bone, projecting perhaps up into the orbit, and requiring removal with the saw, bone-nippers, or gouge. In doing this, care must be taken not to destroy the nasal process of the bone, lest the lacrymal sac be opened.

The tumours that spring from the *Malar Bone*, from the *Cavity of the Antrum*, or from *Behind the Upper Jaw*, are of very various kinds ; epitheliomatous, fibrous, cartilaginous, osseous, fatty, sarcomatous, erectile, and encephaloid growths may all be met with in this situation. In the Museum of University College, which is very rich in specimens of these tumours, most of the above-named varieties will be found. The **Fibrous Tumour** is perhaps the most common ; it principally occurs in elderly people, and may attain very considerable bulk. The large and small spindle celled sarcomata come next in order of frequency ; and the **Osseous, Enchondromatous, Epithelial,** and **Myeloid** are extremely rare. The osseous tumours occasionally appear to set up a spontaneous attempt at elimination, by necrosis taking place in them.

*Situation and Symptoms.*—Epithelial, sarcomatous, and myeloid tumours occasionally spring from the surface of the malar bone, pushing forward the cheek, spreading into the mouth, and involving, with greater or less rapidity, according to their malignancy, the soft structures of the face and the lymphatic glands under the jaw. They are usually rapid in growth, soft and elastic to the feel, irregular in outline, and only secondarily implicate the superior maxilla and neighbouring cavities.

The various growths that are connected with, or spring from, the mucous membrane, or that develop within the antrum, in growing, gradually expand and dilate the walls of the cavity, pressing the bones outwards thinning them, and giving rise to a considerable outward projection of one side of the face, the anterior surface of the superior maxilla being the part that usually first yields to the outward pressure. The tumour thus formed is generally smooth, round, or oval, slightly lobed perhaps, more especially if fibrous, and has in many cases a tendency to hang downwards so as to overlap the lower jaw to a certain extent. As it grows, it encroaches more or less upon the structures lying in the vicinity of the antrum. Thus, it pushes down the palate, causing considerable swelling in the roof of the mouth ; displaces the alveolar processes, and teeth, giving rise to irregularity in their outline; and tending to project into and occupy the alveolus. It may encroach upon the orbit, occasioning stillicidium lacrymarum, impairment of vision, and displacement of the eye-ball. As the tumour enlarges, it obstructs the nasal cavity, and, stretching back into the pharynx, interferes with respiration, and deglutition, and sometimes occasions severe epistaxis. When it is of a malignant character, obstruction of the nasal fossa will be found to be one of its earliest signs, leading to the suspicion of nasal polypus; but the true and more serious nature of the disease will be revealed by the integuments becoming involved, the gums implicated, and perhaps the submaxillary absorbent glands enlarged.

*Diagnosis.*—In the diagnosis of these tumours growing in the upper jaw, there are three principal points to be attended to:—1, to distinguish the growth from fluid accumulation; 2, to determine whether the growth be simple or malignant; and, 3, to ascertain its primary seat.

1. In making the diagnosis from *fluid accumulation in the antrum*, the history of the case, and the uniform enlargement of the cavity without the tumour projecting externally beyond any part of its walls, the elasticity and even fluctuation that may, after a time, be detected, more particularly towards the outer side of the tumour, and at the junction of the mucous membrane of the cheek and the gum, will enable the Surgeon to determine that it is not solid. But in many cases that is not sufficient; and it becomes necessary to make an exploratory puncture by means of the perforator, through one or other of the more thinned and expanded parts already indicated. This should never be omitted in cases of doubt; for it has happened even to so good a Surgeon as Gensoul that, after making incisions through the cheek with the view of extirpating the tumour, the bones were found to be expanded by an antral abscess, and that, consequently, the operation had been undertaken unnecessarily.

2. In determining whether the growth be *simple or malignant*, the Surgeon will experience much difficulty, so long as it is confined to the cavity of the antrum; but when once it has perforated and passed beyond its walls, this point is easily solved. Yet, even whilst the tumour is still confined within the antrum, much light may be thrown upon its nature by attention to the rapidity of its growth; the greater this is, the more reason there is to suspect that it is malignant. Too much importance, however, must not be attached to this sign; for though, as a general rule, fibrous and cartilaginous tumours may increase less rapidly than the malignant, yet they may attain a very great bulk in a short space of time. The age of the patient is of comparatively little value in the diagnosis; I think, however, that, as a general rule, simple tumours most frequently occur in the young, whilst the malignant forms of the affection are commonly met with at the middle or advanced periods of life. It is of much importance, in a diagnostic point of view, to examine the condition of the submaxillary glands. When the disease is malignant, they often become enlarged and indurated at a very early period. In a case under my care, the malignant character of a tumour, whilst still in the antrum, was determined by the fact of there being a long chain of indurated lymphatic glands lying under the angle of the lower jaw, where they had become secondarily affected by absorption, before the bones had been perforated by the growth. It must be remembered, however, that many of the sarcomata which run an essentially malignant course, infiltrating surrounding parts and recurring in internal organs, may at no time affect the lymphatic glands. When once a malignant tumour has passed beyond the cavity of the antrum, and is thus relieved from the pressure of its walls, it grows with great rapidity, and where it can be felt under the skin, is perceived to be soft and elastic. Insinuating itself extensively amongst the bones of the face and skull, it creeps through the foramina and fissures, and encroaches greatly on the nasal cavity and orbit; its early protrusion into these cavities is especially characteristic of

malignancy. It implicates the integuments of the cheek, with an inflammatory œdema, and the soft structures within the mouth, and throws out spouting masses in these several situations, which present all the characters of the true malignant fungus.

3. A point of very great importance in relation to operative interference is to determine the *primary seat of the tumour;* whether it spring from the cavity of the antrum, from the malar bone, or from behind the superior maxilla in the spheno-maxillary or pterygo-maxillary fossa. When it springs from the *interior of the antrum,* the buccal, orbital, nasal, or palatal walls of that cavity are expanded, and the line of teeth is rendered irregular. When the tumour primarily springs from the *malar bone* (Fig. 581), it pushes forward the cheek into a somewhat conical prominence, and dips down into the mouth between the gums and the soft structures of the face. It does not involve the orbit or palate, or alter the line of the teeth; but rather spreads over the bones, and involves the covering soft parts by continuity of tissue, without any definite anatomical disposition. As the tumour increases in size, it will implicate the anterior wall of the antrum, and thus secondarily projects into that cavity. When the disease developes primarily *behind the superior maxilla,* between it and the great ala or the pterygoid process of the sphenoid, the upper jaw-bone is simply pushed bodily forwards, there being little if any deformity in its outline, the line of teeth not being displaced, nor the walls of the antrum—palatal, nasal, or orbital—expanded. Yet it must be borne in mind that the difficulty of diagnosis is greatly increased by the fact that a tumour, though not originating in the antrum, may pass into the orbit through the spheno-maxillary fissure, and may make its way forwards amongst the bones of the face, partly by creeping through, and partly by absorbing and displacing them.

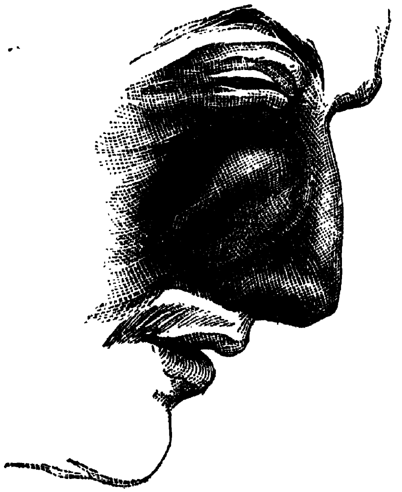

Fig. 581.—Malignant Disease of Malar Bone not suitable for operation.

*Treatment.*—In the treatment of tumour of the upper jaw and antrum, nothing can be done except to extirpate the growth; and it is consequently of great importance to distinguish those forms of the disease in which an operation can be undertaken with safety, and with a fair chance of success, from those in which none should be performed. The three points to be considered are: 1, whether the tumour is benign; 2, if it be benign, whether it grows from the antrum or springs from behind the superior maxilla; or 3, whether it is malignant; and if so, whether it has passed the boundaries of the antrum. When the tumour, springing from the antrum, is of a simple character, the disease should be removed, together with the whole of the superior maxilla; the tumour, whatever size it has attained, being generally encysted, and the bones expanded and absorbed around it; so that it is well bounded, and does not implicate neighbouring parts. Here, as Liston justly observes, no nibbling or grubbing operations should be done, but free excision of the whole mass practised. When the tumour springs from the spheno-maxillary or pterygo-maxillary fossa, pushing the bones of the side of the face forwards, an operation should not be lightly undertaken, as it is doubtful, in many cases, whether the Surgeon can interfere with any prospect of success. Should, however, the tumour be simple, the patient's health be good, and an operation be deemed expedient, the tumour can only be reached by excising the upper jaw, when it may either be removed attached to that bone, or it may be extirpated from the cavity in which it lies behind it, and the bone and cheek shut in over it. Such an operation, implicating as it does the base of the skull, may be followed by death from shock to the nervous centres, as I saw happen in a patient of Liston's thus operated upon; or, involving the internal maxillary artery, may be attended by very profuse and troublesome hæmorrhage. When once a malignant growth of this part has passed beyond the osseous boundaries of the antrum, the question of removal becomes very complicated. In reference to this point, I think that it may be stated generally that, if the cheek be freely movable over the tumour, and the submaxillary glands unaffected, the operation may be proceeded with. But, if it have advanced so far as to implicate the soft structures of the cheek, with enlargement of the submaxillary glands, it is neither wise nor prudent to interfere with it by operation; as infiltration will have taken place more widely than the knife can reach, and speedy recurrence must of necessity ensue. So long as it is contained within this cavity, where indeed it is often impossible to ascertain, until after removal, the true nature of the affection, it may be excised, provided the glands in the neck be not greatly enlarged. If they be much implicated, even though the walls of the antrum be not perforated, it is wrong to interfere, as a cure by operative procedure must be hopeless. Whenever the soft structures of the cheek are involved so as to require partial excision with the tumour, no operation should be performed; as the disease will probably have become constitutional, it cannot be completely extirpated, and will speedily recur in the cicatrix. When the upper jaw on both sides is affected, as sometimes, though rarely, as happened, it is clear that the tumour cannot be removed (*Fig. 582*).

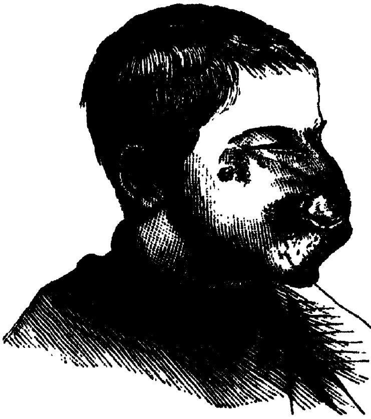

Fig. 582.—Malignant Tumour of the Upper Jaw, involving the whole of the Bones of the Face: not admitting of Operation.

Operations on the Upper Jaw.—The *Operations* that have been practised for the removal of tumours springing from the upper jaw are of three kinds. They consist of—1, Scooping out of the Tumour; 2, Partial Excision of the Superior Maxilla; and 3, its Complete Removal with or without the Malar Bone.

For operations on the upper jaw, the Surgeon will require strong cutting pliers, and two or three narrow-bladed saws, with handles set at different angles, and having movable backs (Fig. 583).

1. **Scooping out the Tumour.**—The practice of scooping out tumours of

the antrum, after turning up the cheek from the anterior surface of the superior maxilla, is one on the propriety of which there is a difference of opinion among Surgeons. Liston, whose experience in these diseases was in his day unrivalled, strongly denounced all "grubbing" operations; and Syme strongly disapproved of the practice. But other Surgeons, whose views on the subject are entitled to the highest respect, advocate and practise this proceeding. For my own part, I look upon the practice as unscientific in principle and disastrous in its results. It is only applicable to the softer kinds of tumours: and these are chiefly myeloid or sarcomatous. Now I hold it to be impossible by gouging, scooping, chiselling, or scraping, to extirpate these from any bone in which they may be developed. It is impossible in this way fairly to go beyond the limits of the disease into healthy structures. Tissues that appear and feel sound, are in reality infiltrated: and hence speedy recurrence takes place. This has happened in every case in which I have seen this operation practised; and the recurrent is worse in all its features—more rapid, more luxuriant, more malignant—than the primary disease. In fact, there is no reason why, in operations on the jaws, we should depart from that principle which is found necessary in operations on other parts for the removal of malignant growths, of being guided in the extent of the removal by the anatomical boundaries of the part affected, and not by the apparent extent of diseased structure. It seems to me to be as reasonable to scoop a myeloid or a malignant tumour out of the head of the tibia instead of amputating the affected bone, as it is to scrape it out of the antrum, instead of extirpating the superior maxilla.

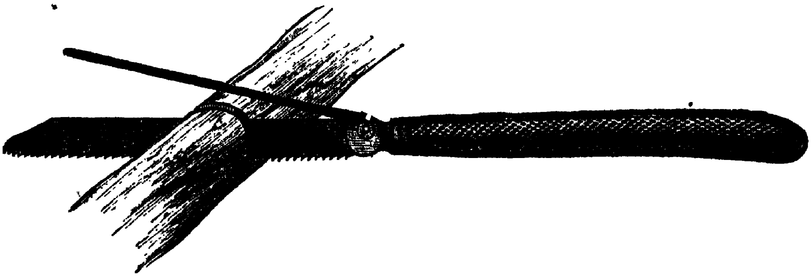

Fig. 583.—Saw with Movable Back, for Operations on the Upper Jaw.

2. **Partial Excision of the Superior Maxilla.**—Although I do not consider the scooping away of the tumour from the antrum to be a proper or surgical procedure, I would not advocate the removal of more of the bones of the face than is absolutely necessary for the complete extirpation of the disease, more especially when that is not malignant. The disease may be limited either to the upper or to the lower part of the superior maxilla. In these cases, the practice of Sir W. Fergusson had led to great advances in our method of removing such disease with the least possible disfigurement and the least loss of bone. With regard to the external incisions in these cases, Fergusson has shown that they often need to be but very limited; all that is necessary being a cut from the angle of the mouth upwards and outwards through the cheek, or, in other cases, a slit through the upper lip on the mesial line, the knife being carried along the side of the base of the columna in the nostrils. By these simple incisions, this distinguished Surgeon has shown, sufficient re-

laxation of parts can be obtained for the excision of the greater part of the superior maxillary bone.

In some cases, the malar bone and floor of the orbit will be found to be sound. When this happens, they should both be left; and with this view, after the cheek has been incised as just described, a deep horizontal groove should be made with a narrow straight-backed saw below the orbit, directly across from the nasal process of the maxillary to the edge of the malar bone. The forceps should now be applied so as to cut downwards and outwards from the end of this incision, and thus to sever the outer connexion between the superior maxilla and the malar bone. They are then to cut along the groove that has been traced horizontally with the saw, one blade cutting from the nares along this; and lastly, the alveolus and hard palate have to be divided. This is best done after the extraction of one of the central incisors, by passing a narrow-bladed saw into the anterior nares and cutting down through the alveolus; the remainder of the section being completed with the forceps. Or the proceeding may be reversed, and the cut made from the mouth up towards the nasal cavity. Should the disease chiefly implicate the upper orbital and nasal portions of the bone, leaving the cheek and roof of the mouth sound, another modification of the operation may be undertaken by carrying the knife from the nasal process down the side of the nose and from the nostril across the cheek, dissecting up the flap thus formed, then applying a narrow-bladed saw from the anterior nares across the superior maxilla above its alveolar ridge, making a perpendicular cut from this into the orbit, and then applying the cutting pliers along these lines of incision, cutting through the superior maxilla, and finally detaching it by dividing with the forceps the nasal process and the orbital plate.

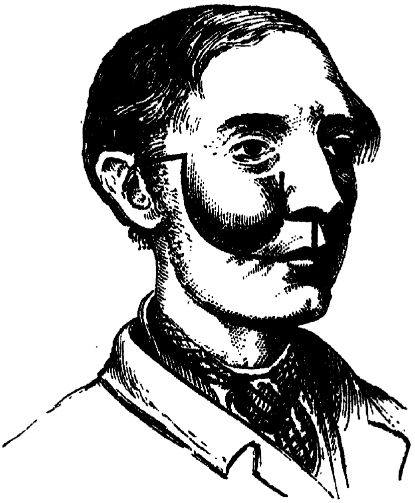

Fig. 584.—Lines of Incision in Liston's Operation for Excision of Upper Jaw.

3. **Complete Excision of the Upper Jaw.**—The operation of excision of the whole of the upper jaw, together with the malar bone, for tumour of the antrum, was first proposed by Lizars in 1826; though Gensoul of Lyons was the first Surgeon by whom the operation was actually performed, in May, 1829. Since then, it has been repeatedly practised; and the names of Liston and of Fergusson are inseparably connected with it, for the skill with which they have devised, and the boldness with which they have carried out the various steps of its performance.

The patient should be placed in a sitting or semi-recumbent position, opposite a good light. The Surgeon stands on the right of the patient. The facial artery should then be compressed as it passes round the lower jaw; or an acupressure-needle may be passed under it; and the hæmorrhage from the incisions into the soft parts thus materially restrained. The parts to be removed should be then fairly exposed by raising a flap from the cheek. This may be fashioned in various ways (see Figs. 584, 585, and 586). The following, which is the method adopted by Liston, will be found to be the most convenient where the tumour is very large (Fig. 584).

In the first stage, the central incisor tooth on the diseased side having been extracted, the point of a bistoury is entered opposite the external angular process of the frontal bone, and carried with a semicircular sweep into the angle of the mouth. From the upper end of this incision, a cut about one inch in length may be carried along the zygoma. Another incision is made from the nasal process of the superior maxillary bone, down to the side of the nose, round the ala, which it detaches, and through the centre of the upper lip into the mouth. The flap thus formed is dissected upwards until the margin of the orbit is reached (Fig. 585); the soft parts are then carefully separated from the floor of this cavity, and drawn upwards by a curved copper spatula, which protects them and the globe of the eye.

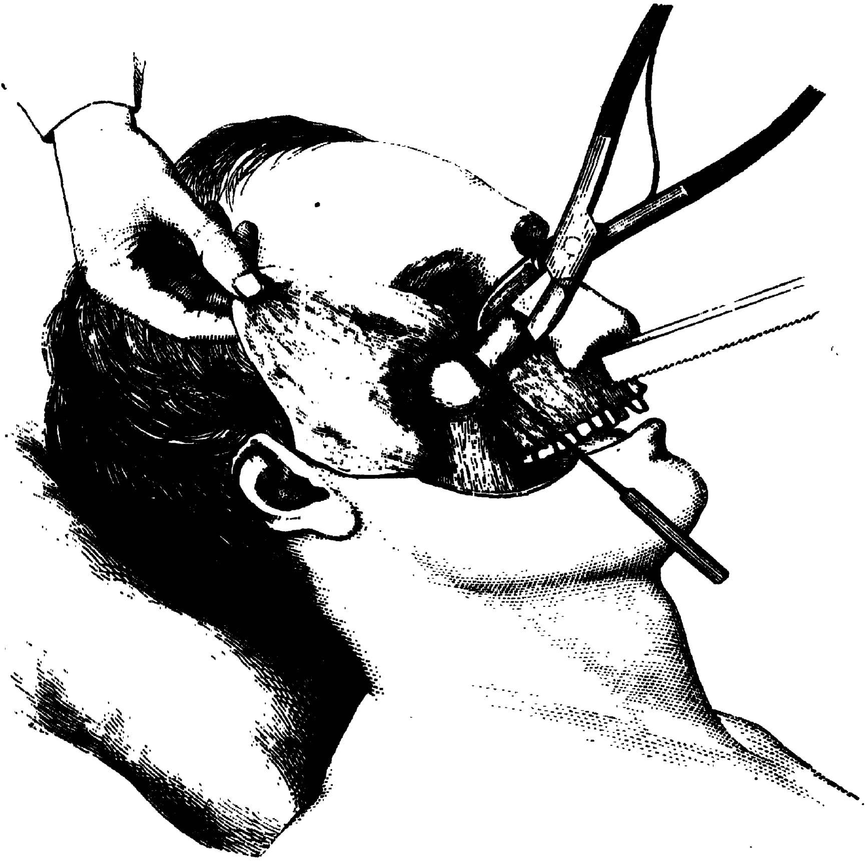

Fig. 585. Excision of Upper Jaw by Liston's Method.

Or the line of incision by external flap (Fig. 586) may be adopted in the following way. The point of the knife is entered opposite the inner angle of the eye, and carried down the side of the nose, round the ala, and down the centre of the upper lip. Another incision is now made in a horizontal direction below the orbit, by entering the point of the knife where the first incision has been commenced, and carrying it directly outwards at the junction of the lower eyelid with the cheek, along the edge of the orbit as far as the zygoma. A flap is then formed and thrown outwards. This line of incision has the great advantage over the one represented in Fig. 584, that the arteries and nerves of the face are cut near their terminations, and not through their larger branches. This line of incision, to which C. Heath gives the preference, is most suitable to tumours of moderate size.

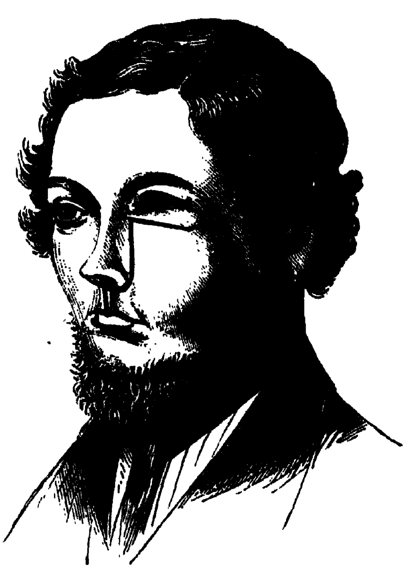
Fig. 586.- Line of Incision in Excision of the Upper Jaw by External Flap.

The next step in the operation consists in the division of the bones. This may best be done with a narrow saw and strong cutting pliers ; the bone being first deeply notched with the saw, and then divided with the pliers ; the zygoma should be first cut across, the external orbital angle next divided in the same way, and then the internal angle cut through by putting one blade of the forceps into the nostril and the other into the orbit (Fig. 585). The palatal arch must finally be cut across by notching it deeply with a Hey's or a narrow-bladed saw, and then, passing the pliers into the mouth and nose, cutting through the line of the groove and the alveolus of the incisor that had been extracted. Or the whole of these steps may be reversed, as the Surgeon finds most convenient. In cutting across the bones, the Surgeon may stand either before or behind the patient.

In the third stage of the operation, the whole mass, having had its osseous connections separated, is depressed, drawn forwards by the fingers on the " lion " forceps, and readily removed by breaking down adhesions with the finger, or by the division of a few remaining soft parts with the bistoury or scissors. Care should be taken to leave the whole of the soft palate intact.

Should hæmorrhage occur from any of the deeper vessels, this must be arrested by ligature, or by the application of the actual cautery. Some strips of dry lint, having a thread attached by which they can be removed when necessary, should then be pressed into the deeper part of the wound, and the cheek-flap laid down in proper position. It must be retained *in situ* by hare-lip pins through the upper lip, and by metallic sutures along the other lines of incision. However much the skin may have been stretched and thinned, none should be removed unless it have been actually incorporated in or infiltrated by the tumour. After cicatrisation is complete, the deformity resulting from such a procedure will be far less than might at first be anticipated.

**Results.**—The result of operations for the removal of the upper jaw is very satisfactory, so far as the operation itself is concerned. Though most serious, the operation is not very dangerous. Of 17 consecutive cases collected by Hutchinson as having been practised in the London Hospitals, it was successful in 14 ; and of 16 cases (10 of total and 6 of partial removal) done by Esmarch, 13 were successful (viz., 8 of the former and 5 of the latter). So far as recurrence of the disease is concerned, all will depend on the nature of the tumour, and the extent of the operation. If the disease be malignant or even myeloid, speedy recurrence will certainly ensue if partial excision or scooping be practised. Nothing, indeed, can be more disastrous than the result of partial operations in these cases. Even though the whole maxilla be excised, the incisions being carried wide of the disease, recurrence is the invariable rule, though the more complete operation secures longer immunity. The liability to recurrence is remarkable in these cases, when we consider how isolated the upper jaw is, being bounded on three sides by the cavities of the mouth, nose, and orbit, and how completely it can be excised. It is, I believe, mainly due to two causes—early implication of the soft parts, and extension of the mischief through the fissures and sinuses behind the bone. These recurrent malignant growths, after removal of the primary tumour, do not admit of extirpation.

When the tumour is benign, the result is most satisfactory and the cure usually complete.

**Tumours that spring from behind the Superior Maxilla** have already been adverted to in speaking of the diagnosis of tumours of the upper jaw (p. 478). They may grow from the sphenoid bone, or from some of the deep cavities lying between it, the palate bones, and the ethmoid, constituting various forms of naso-pharyngeal, palatine, or naso-palatine polypi. Formerly these tumours were either left untouched, or were extirpated together with the superior maxilla or after its removal. Of late years various operations have been devised without the necessity of removing that bone, which is either turned up, down, or on one side. The best operation on the whole for their removal is Langenbeck's **Osteoplastic Section of the Superior Maxilla** with displacement of that bone. The first operation was performed in 1859. Since then, Langenbeck has performed it 13 times, with 10 complete cures and 3 deaths. It has also been performed in Germany by Esmarch, Wagner, Simon, Nussbaum, and Billroth. The last two performed it for removal of the superior maxillary nerve for neuralgia. In America it has been performed twice by Cheever. In one case, it was done for removal of a tumour growing from the body of the sphenoid bone; the tumour recurred, and the operation was repeated at the end of eleven months, with perfect success. In the other case, both bones were displaced at the same operation; but the patient died on the fifth day of "prostration with excitement." In Langenbeck's first operation, the incision was made from the middle of the nasal eminence of the frontal bone towards the right, over the nasal process and downwards to the ala of the nose. The edges of the wound were dissected up so as to expose the whole nasal process of the superior maxillary bone and the nasal bone, the periosteum remaining untouched. The cartilaginous portion of the nose was separated from its bony attachments. The nasal bone was then cut through with bone-forceps, close to the septum, and upwards as far as the nasal process of the frontal bone; by a second cut the nasal process of the superior maxillary was divided into the antrum. The cut ended where the nasal process of the superior maxillary bone forms the lower border of the orbit. The upper part of the nasal process of the superior maxillary and the nasal bone were then prised up and were turned on to the forehead, being still attached by periosteum and mucous membrane. The nose was thus fully opened, and the polypus was removed. The bones were then replaced and supported in position by a plug of charpie. The wound healed readily, and there was no exfoliation of bone. Langenbeck's second operation was undertaken for a tumour springing from behind the superior maxillary bone in the pterygo-maxillary fossa. Two incisions were made; the first began at the insertion of the ala nasi and ran along the lower border of the malar bone, describing an arch with the convexity downwards and terminating at the middle of the zygoma; the second began at the nasal process of the frontal bone, and, following the lower margin of the orbit, crossed the frontal process of the superior maxillary bone, and joined the lower incision. The soft parts were not dissected up. The lower incision was then carried to the bone, and the masseter dissected from its attachment to the malar bone. By depressing the lower jaw so as to remove the coronoid process out of the way, the finger could be forced through the spheno-maxillary fossa, which was dilated by the tumour, into the nose through the spheno-palatine foramen. A narrow saw was now passed along the finger—its point being protected by the forefinger of the left hand introduced into the nostril—and a cut was made directly forwards through the ascending process of the palate bone and the body of the superior maxillary bone, across the cavity of the antrum, parallel to the hard palate and immediately above it. The upper incision was now deepened, and the soft parts were raised from the floor of the orbit and from the angle between the zygoma and the malar bone; and, the saw being again introduced, a cut was made through the malar bone into the spheno-maxillary fissure, and thence across the floor of the orbit as far as the lacrymal bone. The wedge-shaped piece of the superior maxillary bone included between these cuts was now only attached by its connections with the nasal and frontal bones, and by the soft parts covering it, which were untouched. By introducing an elevator into the cut in the malar bone, the whole piece was lifted up, bending upon its attachment to the nasal and frontal bones as upon a hinge, until it was completely turned inwards and upwards over the opposite side of the face. The tumour, which was found to have extensive connections in the pterygo-maxillary region, was now removed. The bone was then replaced, and the wound closed. On the sixth day, the greater part of the wound was healed; on the sixteenth the wound had completely healed, and no mobility could be felt in the bone. Ollier removed a polypus from the nasal fossa, by making a horseshoe-shaped incision from one ala of the nose up to the root, and then across the root and down to the other ala. He then sawed through the nasal bones and the nasal process of the superior maxillary bone, and so opened up the superior meatus of the nose.

These operations have been successful in many cases which would have necessarily been fatal if left. But they must not be lightly undertaken, as the danger of the operation itself, and the possibility of death during or soon after its performance, must be borne in mind. There are three main sources of peril in these cases, viz., hæmorrhage, asphyxia from the passage of the blood into the pharynx and larynx, and shock to the nervous system, from the close proximity of the operation to the base of the brain. The danger of asphyxia from hæmorrhage into the air-passages may be obviated by a preventive tracheotomy, and the use of Trendelenburg's apparatus.

## DISEASES OF THE LOWER JAW.

TUMOURS not unfrequently spring from the lower jaw. Like those in the superior maxilla, they may either be simple or malignant. Amongst the simple, we most commonly find the **Fibro-cystic.** **Fibrous** tumours are also occasionally met with, and more rarely **Osseous** and **Enchondromatous** growths. The malignant tumours are principally rapidly growing sarcomata. These various growths frequently occur in early and middle life, and usually spring from the diploë between the two tables of which the bone is composed. They project into the mouth and on the side of the neck, forming large rounded uniform, or imperfectly lobed masses. Occasionally malignant diseases spring from the neighbourhood of the bone, and, without invading its structure, envelop it so as to give rise to an appearance of morbid implication of it.

In the *Cystic* and *Fibro-cystic Tumours* of the jaw, the growth is expanded into cysts, having more or less solid matter intermixed, partaking of the character of epulis. The cysts are of various degrees of thickness; some being thin and membranous, others having the walls partly composed of fibrous tissue, and others again having expanded bony lamellæ largely entering into their composition, so that on pressure they occasionally communicate the semi-crepitant sensation peculiar to the cystic expansions of the osseous structure. The fluid contained in these cysts is a viscid liquid, usually semi-transparent, yellowish, or bloody.

*Diagnosis.*—In the lower, as in the upper jaw, it is of great importance to diagnose the simple from the malignant affections; as in the latter form of disease an operation is rarely justifiable, the soft tissues around the bone being usually implicated to such an extent as not to admit of removal, and consequently not of the full and complete extirpation of the disease. The malignant tumours may generally be readily detected by the rapidity of their growth, by their pulpy or elastic character, and by infiltration of neighbouring parts, with implication of the glands below the jaw.

*Treatment.*—The treatment of tumours of the lower jaw depends in a great measure upon the character of the growth. In cystic tumour of moderate size, with thin walls and but little deposit of fibrous tissue around the cysts, the best mode of treatment consists in cutting down through the gum on the expanded portion of bone, opening the cyst by means of the antrum-perforator, small trephine, or cutting pliers, according to its size and the thickness of its walls: letting out the fluid contained within; and then, by introducing a plug of lint, causing the cavity to granulate from the bottom, and gradually to contract. When the cysts are so large that they have destroyed the integrity of the bone, or when they are associated with a large quantity of fibrous tissue, so as to constitute true fibro-cystic tumours, excision of the diseased bone must be practised. This, also, is the only plan of treatment that can be had recourse to in other affections of this bone.

**Excision of the Lower Jaw.**—The operation of excision of a portion of the lower jaw for tumour of that bone was first performed by Deadrick of Tennessee, in 1810, and not, as is generally but erroneously supposed, by Dupuytren. As the growths for which this operation is performed are usually situated between the symphysis and the angle of the bone, seldom extending beyond the middle line, the operation is generally limited to one side of the face. In some instances, however, the tumour may encroach so far that it may be necessary to remove more than the half of the bone; and in other cases again, though of very rare occurrence, the whole of the bone has been disarticulated.

When the tumour is of moderate size, and is situated about *midway between the symphysis and angle* of the jaw, it may be reached by making a semilunar incision of sufficient length under the lower edge of the bone, and carrying the anterior extremity of it well forward upon the chin, but not dividing, if possible, the lower lip, nor cutting into the angle of the mouth; then dissecting up the flap thus formed, and carrying the knife cautiously along the inner side of the jaw, so as to detach the mucous membrane of the mouth and the mylohyoid muscle to a sufficient extent. In doing this, the hæmorrhage is often very profuse: the bleeding from the facial artery is particularly forcible, the blood being thrown in a larger and stronger jet than would seem possible from the size of the vessel. The hæmorrhage should be at once controlled by the application of ligatures to both ends of the bleeding artery, and to any other points from which it is more than usually abundant. Unless this be done, the after steps of the operation will be rendered much more obscure and difficult. One of the teeth on each side of the tumour having been previously drawn, the jaw must now be deeply notched through their alveoli into its base with a narrow strong-backed saw, and cut through with pliers, or completely divided with the saw. After the fragment of diseased bone, with the attached tumour, has been removed, and all bleeding vessels have been secured, the flap of cheek should be laid down smoothly, and retained *in situ* by means of hare-lip pins. Occasionally the dental artery in the cut jaw gives trouble; the hæmorrhage from this source may be checked by the application of a piece of solid perchloride of iron. In all operations for the removal of portions of the lower jaw, it is most important to avoid, as far as possible, opening up the mucous membrane of the mouth, so as to prevent the entrance into the buccal cavity of blood during the operation, and of discharges after it. The patient must be fed with slops, which should be sucked in through a tube. At a later period, when cicatrisation is well advanced, the teeth should be tied together with strong silver wire; or a silver cap should be fitted upon the teeth of the two portions of bone that are left, and attached by an elastic spring to another silver cap put on those of the upper jaw, so as to prevent the displacement that would otherwise occur in the smaller fragment. Union takes place after a time by fibrous tissue, which becomes sufficiently dense to make the jaw strong and useful.

In those cases in which the tumour *encroaches upon the angle and ramus* of the jaw, it is usually better to remove the bone at the articulation on the affected side; for, if the articular end including the coronoid process be left, it will be displaced forwards and upwards by the action of the temporal and external pterygoid muscles, and be a source of much inconvenience and irritation to the patient, not compensated by any corresponding utility. In these cases, the removal of one lateral half of the jaw will consequently be required, and the operation may be performed in the following way. The point of a strong bistoury or scalpel should be entered immediately behind the articulation, carried down the posterior margin of the ramus behind the angle, and under the body of the bone beyond the anterior limits of the tumour, where it must

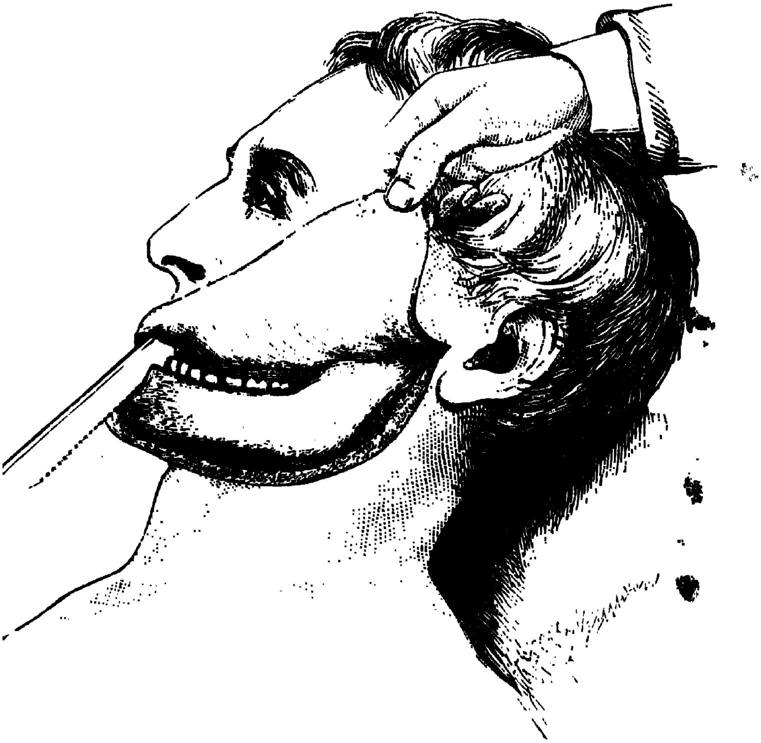

Fig. 587.—Excision of Lower Jaw. Soft parts raised.

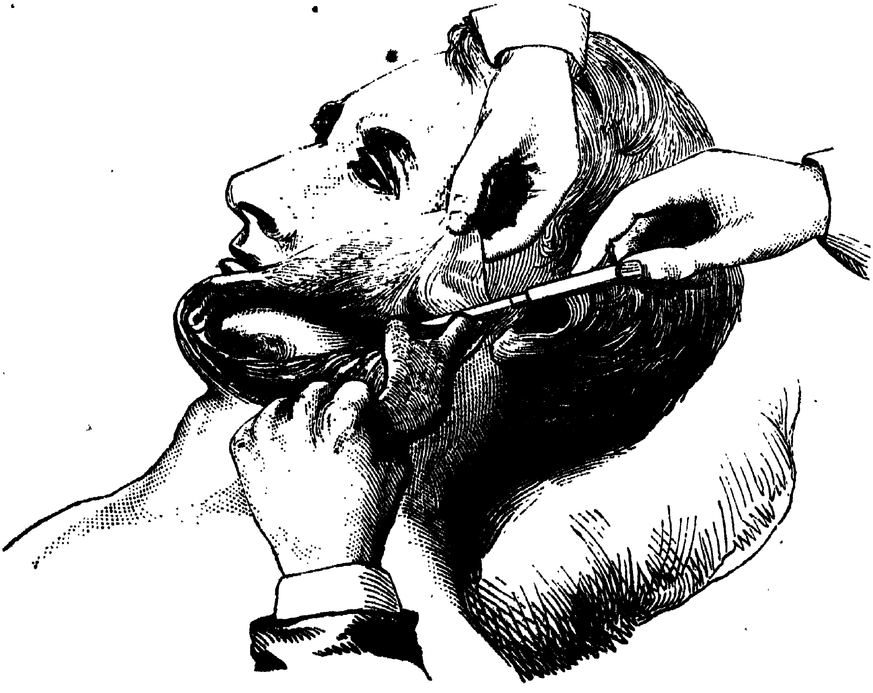

Fig. 588.—Excision of Lower Jaw. Disarticulation of Condyle.

slope gradually upwards, terminating at some distance from the lips, which should not be encroached upon; the convex flap thus formed is dissected up, and the facial artery and any other branches requiring ligature tied. The knife is then carried behind the jaw in front of the tumour, and, one of the incisor teeth having been extracted before the operation commenced, a saw should be applied to the bone in this situation, and its section finished by means of the cutting-pliers (Fig. 587); the Surgeon then dissects under and around it; in this situation a scalpel, curved on the flat, will be found useful, the edge of the knife being kept close to the bone and tumour. When he has cleared the tumour and ramus, he depresses the body of the bone forcibly with his left hand, in order more readily to divide the attachment of the temporal muscle to the coronoid process. This having been done, the only part left is the disarticulation, which is best effected by opening the joint from the front, whilst the bone is well depressed and twisted somewhat outwards, the edge of the knife being kept close to its neck, scraping the bone so as, if possible, to avoid wounding the internal maxillary artery, when, any remaining attachments having been cut through, the disarticulation is effected (Fig. 588). In depressing the bone to reach the temporal muscle and the joint, care must be taken not to use too much force, lest it happen that the ramus give way, having been weakened by the disease; this accident would produce a good deal of trouble in removing the fragment left behind, which can only be done by seizing it with necrosis-forceps, thus dragging it forwards, and then dividing the muscle and capsule. Should the internal maxillary artery have been divided, it must be ligatured, or the termination of the external carotid, where the vessel divides into the temporal and internal maxillary, tied: any other branches that bleed will necessarily also require the ligature. The cavity, having been lightly filled with lint, should then be left to granulate; the cheek being laid down and attached along the line of incision by hare-lip pins and twisted sutures. A kind of fibrous tissue forms in place of the jaw that has been removed, and comparatively little deformity results. When the disease of the bone extends *beyond the symphysis*, a thick ligature should be passed through the end of the tongue, which must be drawn forwards by an assistant, lest, on the division of the insertion of its muscles into the lower jaw, it be forcibly retracted into the pharynx, and thus threaten or even occasion suffocation, as has happened to Surgeons of eminence both in France and in America.

For necrosis of the lower jaw, and the operations for it, see Chapter XLVI.; and for tracheotomy in operations on the jaws, see Chapter LX.

# CHAPTER LVIII.

## PLASTIC SURGERY OF THE FACE AND MOUTH.

By **Plastic** or **Reparative Surgery** is meant the performance of operations for the repair of deficiencies in structure, whether resulting from injury, from disease, or from malformation.

It has been long known that partially detached portions of the body may retain their vitality sufficiently to become again adherent, when attached but by a very narrow tongue of tissue to the part from which they have been all but separated. This has often been observed in injuries of the face and fingers, portions of which have been nearly completely severed, and yet have united again on being replaced. But there is a sufficient number of cases on record to show that certain parts, when completely separated, may, after being replaced, again become adherent. The most remarkable instances of this kind are those which are related by Hoffacher, and attested by Chelius and Velpeau. Hoffacher was officially appointed to attend as Surgeon at the duels which were at one time frequent amongst the students at Heidelberg ; and, as at these encounters broad-swords were used, he had an opportunity of seeing a considerable number of incised wounds, and has related no fewer than sixteen cases in which portions of the nose, lips, or chin had been sliced off, and, being put on again, contracted adhesions. Amongst the most remarkable of these, is one in which the end of the nose was sliced off by a cut with the broadsword, and fell under a chest of drawers ; it was not found for some time, but, on being recovered and washed, was stitched on, and became firmly attached. In another instance, a dog that was in the room snapped up the detached portion of the organ as it fell to the ground, but the nose, being immediately taken out of the animal's mouth and put on again, became firmly fixed.

In order that union should take place between parts that have been separated completely or nearly so, and the rest of the body, it is necessary that they be soft and vascular, and more especially that their structure be of a homogeneous character, such as is met with in the tissues of the face ; where no very large blood-vessels, nerves, tendons, or bones are found. It is the same in plastic operations, which succeed best under similar conditions of tissue, and which are conducted on the same principle as an attempt at union in a partially severed structure.

It is principally for deformities and loss of the nose and lip that plastic operations are of much service ; they may, however, occasionally be had recourse to in other situations, as about the cheeks and eyelids, but seldom with an equal amount of success. Reference has already been made (p. 657, Vol. I.) to the performance of plastic operations on the perinæum. In the practice of this very interesting branch of surgery, there is much opportunity for the display of manual dexterity. On this, indeed, almost the whole success of the operation depends; and a vast deal may be done in apparently the most unpromising cases by management, skill, and patience. In these operative procedures the names of Serres, Dieffenbach, Liston, Fergusson, Sédillot, B. Langenbeck, and Jobert, deservedly take the first rank.

In performing the various plastic operations, four methods have been employed. In the first, the flap of skin that is intended to repair the lost structure is transplanted from a distant part, as the arm. This operation, which was introduced by the Italian Surgeon, Tagliacotius, and hence commonly called by his name, has in a great measure fallen into disuse, on account of the difficulty of its execution, and the great uncertainty of obtaining a successful result. The second plan consists in transplanting the reparative structure from some part in the neighbourhood of the organ to be repaired; the skin from the forehead, for instance, being used for the formation of a new nose; that from the chin for the restoration of a lost lip. This procedure, which seems first to have been adopted by the natives of India in restoring the loss of the nose, is the method that is most commonly employed in this country in plastic operations on the face. The third method consists in loosening the skin by a process of subcutaneous section to some distance around the part to be repaired, and then drawing it forwards with or without incision through its substance. This gliding operation is chiefly practised for the closure of fistulous openings. The fourth method is employed in cases where an abnormal fissure exists in a part. It consists in bringing together and uniting the edges of the fissure, after having pared them evenly, so as to expose their vascular surfaces.

Union in plastic operations is effected by primary adhesion between the raw surfaces which are brought into contact. Should, however, this mode of union fail from any accidental circumstance, the Surgeon need not despair; as the parts may unite by adhesive inflammation, or even through the medium of granulation, in a very satisfactory and complete manner.

For proper union to be effected, it is necessary that the edges be cleanly and evenly cut, so as to adjust themselves accurately to one another. This may often be most skilfully effected by making the incision in the part that is to receive the flap somewhat oblique or bevelled, thus securing a more accurate adaptation of the edges.

After the flap has been formed and the part in which it is to be transplanted properly pared, the operation should be delayed a few minutes until all bleeding has ceased. This is of much importance, as the interposition of a layer of coagulated blood will materially interfere with union.

In bringing the parts into apposition, great care must be taken that no undue traction or constriction be exercised, lest their circulation be interfered with, and their vitality be endangered.

The parts may be maintained in apposition by sutures, collodion, or the application of a strip of isinglass plaster. The sutures should be as fine as possible, introduced with a small needle, and knotted on the sound parts. Occasionally, as in hare-lip, pins may advantageously be used. In some instances, instead of sutures, a small spring-forceps (Fig. 80), termed a *serrefine*, may be employed, but most generally interrupted sutures are the best. The use of collodion, where applicable, is of great advantage in plastic surgery, as it not only secures adhesion, but, by excluding the air, lessens the chance of suppuration.

For a plastic procedure to succeed, it is absolutely necessary that no morbid action be going on in the seat of operation ; and not only that none be actually in progress, but that all have ceased for some considerable time. This is more particularly the case when the deformity for the remedying of which it is practised has resulted from syphilitic or cancerous ulceration. In both cases it is necessary to see that the constitution is sound, as well as that all local disease has been eradicated ; otherwise the irritation of the operation might set it up again, and the new flap might be invaded and destroyed. From want of this precaution, I have more than once seen disappointment result. When an operation, as on the nose or lip, is performed for cancroid disease, ablation of the morbid part may be done at the moment of operating—the affection being a local one ; when for struma or syphilis, the disease is constitutional, and care must be taken that all morbid action has thoroughly and completely ceased. As a general rule, plastic operations practised for the repair of mutilations from injury, or of congenital deficiencies, are more successful than those that are performed after disease.

No routine system of treatment should be adopted ; but a few days of rest, good diet, and a dose or two of aperient medicine, may be prescribed before the operation is proceeded with. In the after-treatment of the case, a nourishing but unstimulating regimen should be observed.

**Burow's Operation.**—A plastic operation specially suited for the repair of deformity consequent on the removal of morbid growths from the cheeks and other parts of the face, has been introduced by Burow, a Polish Surgeon, and successfully performed and described by Stokes (Fig. 589). The steps are as follows. The growth to be removed is included in three incisions, 1, 2, 3 ; and the integuments from which it springs are then carefully dissected off, leaving a raw triangle, the apex of which is on one, the base on the other side of the tumour. The incision 1, 4, 3, is then carried outwards to 5, 8, 7, so that the whole distance from 1 to 7 is exactly three times that of the base of the raw surface ; a second triangle, 5, 6, 7, is then made, having its base on the outer third of this horizontal incision. The two triangles must be of equal size, and the integuments are dissected off 5, 6, 7. There are thus two raw surfaces to be covered in. This is done by dissecting up carefully the flaps 1, 5, 6, and 2, 3, 7. When this is done, the points 1 and 3, and 5 and 7, are respectively drawn together, each by one suture, and the two raw triangular surfaces are thus covered in.

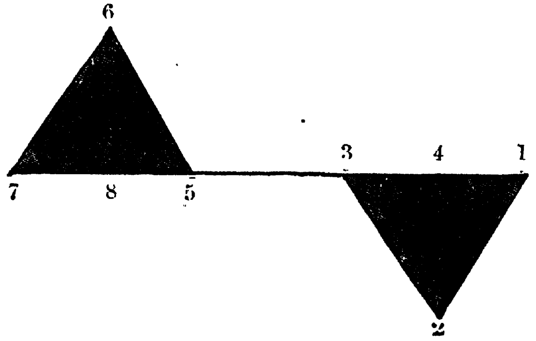

Fig. 589.—Lines of Incision in Burow's Operation.

Operations of various kinds are frequently performed on the eyelids, which are truly of a plastic character.

**Blepharoplasty**, or the operation by which the eyelids are repaired, is occasionally required for loss of substance—the result of wounds, cicatrices, or operations. It is less satisfactory in its results than most of the other plastic procedures about the face ; yet it may, in some cases, improve materially the patient's appearance.

When the upper eyelid requires repair, the flap is taken from the forehead : when it is the lower lid, from the cheek or temple. This operation may be performed either by the gliding method, or by twisting a flap into its new situation. By the gliding method, a triangular flap is cut and partially detached (Fig. 590, *a*), and then drawn gently forwards until it corresponds to and fills up the gap that requires repair, when it is there fixed by a few points of suture. When the twisting method is employed, an oval flap is detached (Fig. 590, *b*), except its pedicle, and twisted down, to be planted on the raw surface.

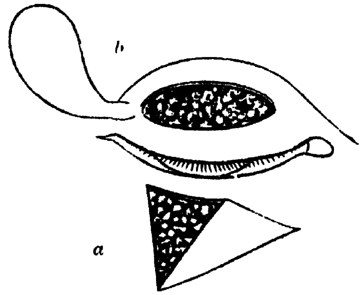

Fig. 590.—Operation for Repair of Eyelid : (*a*) Gliding Method ; (*b*) Twisting Method.

Occasionally neither of these methods is applicable ; and then the procedure, that I successfully adopted in a case of which the annexed cut (Fig. 591) is a representation, may be followed. In this case, which was that of a lady who had received a severe mutilation of the face by the explosion of a ginger-beer bottle, there was a deep and hard cicatrix across the lower eyelid, causing depression and eversion of its outer portion, and adhesion of the inner part to the ball of the eye. After dividing the adhesions and removing the cicatrix, I made a semilunar incision so as to dissect up the eyelid, and then fixed it by points of suture in its new situation, when it became firmly adherent (Fig. 592), and scarce any apparent deformity was left. In another very similar case, in which a girl had been bitten through the lower eyelid by a dog, a similar operation was practised with equally good results. In both these cases, the eyeball, having been injured, had become atrophied, with opacity of the cornea. But, when an artificial eye was adjusted to the shrunken globe, the appearance of the patient was most satisfactory.

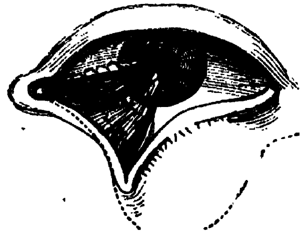

Fig. 591.—Lower Eyelid deformed by Cicatrix.

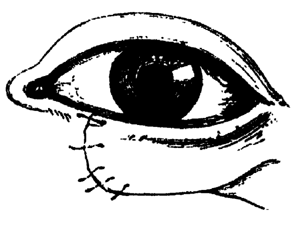

Fig. 592.—Lower Eyelid after Operation.

The operations for Symblepharon, Entropion, and Ectropion, have been described in the chapter on Ophthalmic Surgery (pages 417—419).

### PLASTIC SURGERY OF THE NOSE.

RHINOPLASTIC OPERATIONS occasionally require to be performed for the restoration of the form of the nasal organ, which has been destroyed by injury or disease. This branch of plastic surgery has long received much attention, and has been reduced to distinct rules. Either the entire nose, or a portion, may demand operation.

**Columna.**—When the columna and a portion of the septum are destroyed, a large gap is left at the nasal aperture; and, the nose becoming flattened in consequence of its tip falling in, great deformity necessarily results. The upper lip also, losing that amount of support which it receives from the columna, becomes pendulous, projecting, and thickened at the end, thus adding to the disfigurement. The restoration of the columna is effected from this thickened and prominent upper lip, which, by being reduced in size, is rendered far more shapely. The operation consists in cutting through the whole length of the lip from above downwards on each side of the mesial line, so as to leave a tongue about one-third of an inch in width. This is then turned up; and its ends being well pared, and the under surface of the tip of the nose properly vivified, it is fixed by means of a fine hare-lip pin and twisted suture, which should be left in for about four days. Union takes place in a few days; but until this is firm, the new columna must be properly supported with narrow strips of plaster fixed to the cheek on each side. No twisting of this small flap is required, as the mucous surface speedily becomes cutaneous, and *vice versâ.* The division in the upper lip must be treated in the same way as an ordinary hare-lip, and unites without difficulty, lessening greatly the deformity in this part.

**Ala.**—When one ala only is deficient, the rest of the nose being sound, one of three processes may be adopted to remedy the deformity. 1. When a small portion only of the free border or of the tip has been lost, an incision should be made (Fig. 593) across the nose, and the remains of the ala and a portion of the nasal integument thus marked out dissected down, and attached to the end of the organ. In this way a very excellent result may be obtained.

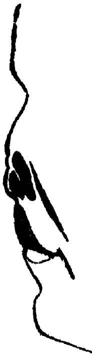

Fig. 593.—Deficiency of Ala of Nose.

2. If the loss of substance be greater, a flap of skin, of the proper shape to restore the deformity, may be raised from the cheek, applied to the previously pared edges of the part requiring it, and fixed there by a few points of fine suture.

3. If the loss of the substance of the ala be very considerable, or if it extend to a part of the body of the nose, then it is more efficiently restored by bringing a long narrow flap from the forehead in a way that will immediately be described. In the majority of cases, the destruction of the ala and of the body of the nose is so considerable, that other plans, to be presently described, are required for the repair of the deformity.

**Entire Nose.**—For the restoration of the entire nose, two procedures have been employed: viz., 1, the Tagliacotian Operation; 2, the Indian Operation.

1. The **Tagliacotian Operation** consists in taking the integument and areolar tissue required for the repair of the lost organ from the inside of the arm. Here a flap of sufficient extent is to be marked out and dissected up with its subjacent areolar tissue, leaving it merely attached to the limb by a root at its distal end. No attempt at fixing this flap to the nose should be made for at least a fortnight, during which time it should be kept upon a piece of wet lint, and allowed to thicken, granulate, and become vascular, so as to fit itself for adhesion to the new surface to which it is to be applied. The remains of the deformed nose having then been properly pared and the flap shaped, they must, after all bleeding has ceased, be properly adjusted and fixed to one another by points of suture. The arm must then be closely attached to the head, so as to be as nearly as possible immovable. At the end of about ten days, when adhesions have taken place, the connecting medium may be cut across, and the part left to be supported by the vitality which it may gain from the new surface to which it is now attached. This process is comparatively seldom had recourse to, for obvious reasons. The uncertainty of maintaining the vitality in the flap, the extreme tediousness of the prolonged constrained position in which it is necessary to keep the patient, and the great difficulty of guarding against movements of the arm, especially during sleep, and which, however slight and involuntary, would be sufficient to disturb union between the opposed surfaces, and occasion the failure of the operation, have caused this plan of procedure to fall into disuse; and it is now, I believe, universally abandoned by Surgeons in this country, having been replaced by the more certain procedure, which will now be described, of borrowing the skin for the new nose from the forehead.

2. The **Indian Operation**, a knowledge of which was brought to this country by Carpue in 1814, is extremely successful in its results, though requiring a good deal of nicety for its proper execution. The operative procedures required by this method are somewhat complex, and may conveniently be divided into three distinct periods: 1, the Dissection of the Flap from the Forehead, and its Attachment to its new situation: 2, the Separation of the Root of the Flap where it is turned down from the Forehead, and the Formation of a proper Bridge to the Nose; 3, the Formation of the Columna Nasi.

1. **Formation and Attachment of the Flap.**—In the shaping of the flap, care must be taken that it is of sufficient size; as during the after-part of the treatment it often has a tendency to shrivel, and more inconvenience usually results from its not having originally been made large enough, than the reverse. The size adapted to the particular face may best be judged of by moulding a thin piece of gutta-percha to the nose, then flattening it out by dipping it in hot water, and using this as the guide for marking the outline of the flap upon the forehead. This should be traced with tincture of iodine, which will not be washed off so readily as ink by the flow of blood, which is often rather free. This flap should be of the shape in Fig. 594, taking care that it is rather square at the angles, and not too much rounded off. The size will necessarily vary according to the character of the countenance, and the

extent of loss that has to be repaired. When the whole of the nose requires restoration, it is usually necessary to make it about two and a half to three inches in length, by about the same in width at the broadest part. It may either be taken from the middle of the forehead, or obliquely from one side: if the latter, the right side is the most convenient. It must now be dissected off the forehead; in doing this, care must be taken to cut the flap as thick as possible, especially at its root between the eyebrows. It must also be but little handled, and, above all, not pinched, either with fingers or forceps. The dissection should be commenced at the root, so that the outline may not be obscured by blood; and this part should be left long, in order to admit afterwards of a very gradual and easy twist. In order to facilitate this, it is also desirable to make the incision on the right side a little lower than that on the left. After the flap has been raised throughout the whole of its extent, a piece of wet lint should be applied to the forehead, with a view of arresting the bleeding, before the next step is taken. This consists in paring the surface and edges of the stump of the nose, and removing the integuments from it in such a way as to leave a triangular raw surface. In doing this care must be taken—whilst a good base of attachment is left—not to remove the parts too widely, lest the cheeks, by separating, have a tendency to gape too much, and the nose to become flattened out. The integuments also should be dissected away in such a manner as to form a deep groove shelving inwards, so as to receive and hold the flap more securely and with less overlapping of the edges. The operation must now be discontinued for a few minutes until all bleeding has ceased, and the cut surfaces have become glazed; this point is of great importance in securing direct adhesion, and must be carefully attended to. The bleeding having been arrested by exposure to the air, and by the torsion rather than the ligature of any spouting branch, the flap from the forehead should be brought down by a twist from left to right, and attached by a few points of fine suture on each side to the edge of the incision, around the nasal aperture. A pledget of soft lint, moderately greased, should now be gently insinuated under the flap, the lower part of the incision in the forehead drawn together by a point of suture, but not so as to constrict the root in any way, and the rest of the exposed surface covered with water-dressing. The parts will then present the appearance of

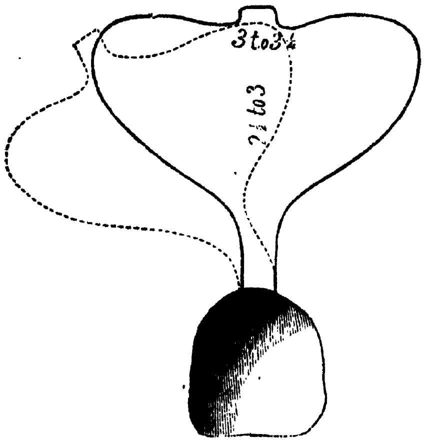

Fig. 594.—Diagram of Flap in Rhinoplastic Operation.

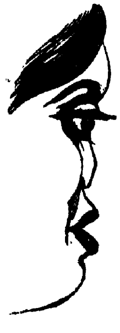

Fig. 595. Depressed Nose.

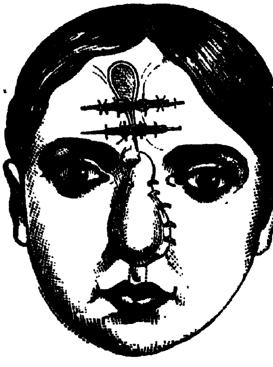

Fig. 596.—New Nose, day after Operation.

Fig. 596, taken from a patient of mine the day after the operation. Fig. 595 represents the deformity for which the operation was performed. The patient should be put to bed with a piece of soft lint laid over the whole of the face, so as to maintain its temperature; and, if it be winter, he must be placed in a room that is kept well warm day and night. The diet for the first few days should be simple, but abundant, consisting chiefly of nutritious slops.

The dressings must not be disturbed for three days: by this time, if all go well, the flap will be found somewhat tumid, warm, and sensitive, but pale in colour. The plug in the nose will now require changing, lest it be rendered offensive by the discharges; its withdrawal and the substitution of another must be done with the greatest gentleness, the Surgeon bearing in mind that any undue pressure or traction may destroy adhesions, and prove fatal to the vitality of the flap. If the sutures produce no irritation, they may be left in till the fifth or sixth day, by which time the adhesions will be tolerably perfect, and they may with safety be cut and withdrawn. As the adhesions strengthen and the vitality of the flap improves, it must be elevated by putting underneath it a larger plug of lint; for which, after a time, may be substituted a small gutta-percha tube moulded to the figure of the inside of the nose. Œdema of a somewhat solid character is apt to come on in the flap, giving it a white appearance; but this is of little moment, and will gradually subside as the circulation through it becomes more actively established. The flap gradually becomes thicker and firmer, throwing out granulations from its under surface, which eventually becomes clothed with mucous membrane. The wound in the forehead must be dressed like an ordinary ulcer, and be well touched with nitrate of silver from time to time, to insure its contraction. It usually cicatrises with great readiness, and leaves remarkably little deformity.

2. **Separation of the Root of the Flap.**—This may be done about a month after the flap has been fashioned, when its vascularity, through its lateral adhesions, will be perfected. The division of the root is best done by passing a narrow-bladed bistoury under the twist, and cutting upwards towards the eyebrows, removing a wedge-shaped portion of the soft parts, so as to make a smooth and proper bridge.

3. **Formation of the Columna Nasi.**—The addition of the columna is now all that is wanted to make the nose complete. This must be made from the upper lip, perhaps at the same time when the bridge is fashioned; and it may be cut and fixed in the way that has been already described in speaking of the restoration of this feature, the interior of the apex of the new nose having been well pared to receive it. The columna requires to be well supported by means of a narrow strip of plaster passing from one cheek to the other, and usually requires a good deal of fashioning before it is perfect; indeed, this is the part of the operation that I have found always most troublesome, and requiring most attention.

The new nose must continue to be supported from beneath, for some months after its formation, by plugs of lint or small gutta-percha tubes, as it will evince a great tendency to contract and to alter in its general outline and shape; becoming, if the Surgeon be not careful, either depressed or dumpy. The sensibility of the new nose is entirely destroyed for a time after the division of the bridge; but it slowly returns from all sides, appearing first in the neighbourhood of the adhesions between it and the cheeks, then near the columna, next in the bridge, and thus the organ at last has its sensation restored; for this, however, several months will usually be required, and the part in which it returns last of all is its central portion.

The annexed cuts (597, 598) give a very faithful representation of a patient on whom I operated, before and after the restoration of the lost organ.

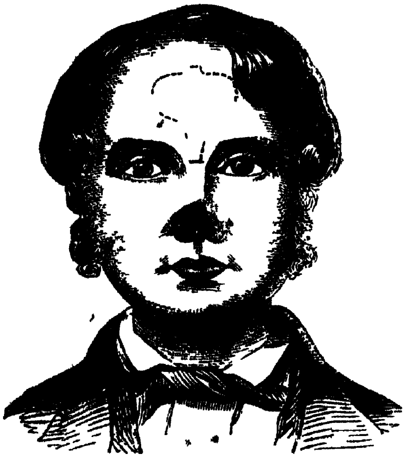
Fig 597.—Patient before Rhinoplastic Operation

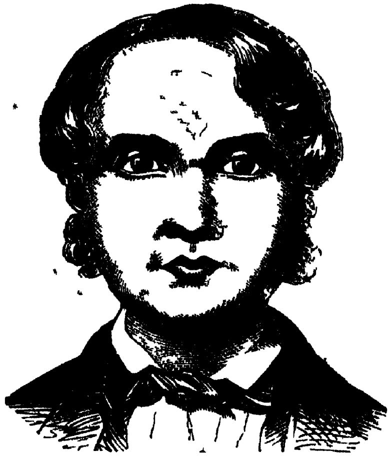
Fig 598. Same Patient some months after Operation.

The success of the case will depend very greatly upon the minute attention which the Surgeon bestows on the details of the operation, and on the care which he takes in the after-treatment. During the operation, the chief points to be attended to are, that the flap be made of sufficient size, that all oozing have ceased before the cut edges are brought into contact, and that no tension nor constriction be exercised. A principal source of failure in the operation, or in the result so far as concerns the after-appearance of the patient, is gangrene of the flap, in whole or in part, arising from the root being too narrow or too tightly twisted, or from the flap being too roughly handled in its dissection. So also, if it be cut too small and not properly supported afterwards, the result will not be very satisfactory. Other accidents occasionally happen; thus, erysipelas may occur, destroying at once the vitality of the flap, or coming on at a later period, and causing the new nose to slough under the attack of inflammation, which it has not sufficient vitality to resist, as happened in one of Liston's earlier cases; or the new nose may be destroyed by a return of the lupus which proved destructive to the old one. Hæmorrhage may also occur from underneath the flap. In the last case operated on by Liston just before his death, and which was completed by Morton at University College Hospital, hæmorrhage to the extent of more than a pint took place on the ninth day, without any evident cause, from under the flap, and could only be arrested by plugging. Further, the operation is not without its dangers. Dieffenbach lost two patients out of six on whom he operated in Paris; their constitutions having probably been in an unfavourable state.

The operation as just described will usually be attended by very satisfactory results. Of late years some modifications have been introduced into it. Thus Langenbeck recommends that the periosteum should be dissected up from the frontal bone together with the skin-flap, in order that, by the after-development of osseous tissue, a firmer and better organ should be left. It has been feared by some Surgeons that the exposure of the frontal bone, by stripping off its periosteum, would probably be followed by necrosis. Experience has, however, shown that this fear is groundless, as, indeed, might have been inferred from analogous conditions often observed in injuries of the head, in which large portions of the pericranium may be detached without the exposed bone losing its vitality. But it appears to me that there are more serious objections to "Osteo-Rhinoplasty," and that it is an unnecessary complication of the operation to turn down the pericranium in the nasal flap, for two reasons. First, the pericranium is very firmly attached to the bone, and very loosely to the integumental structures, which glide over it. From the bone it is not detached without difficulty and the necessity of a certain degree of scraping, by which its vitality is not unlikely to be impaired to so great a degree that it would be of no service as a bone-producing organ in the new nose, and would not improbably, when twisted down, slough away from insufficient vascular supply. Secondly, even if the pericranial lining of the new nose were to retain its bone-producing power, it seems to me that an osseous layer inside that organ would rather be a disadvantage than of service, and would certainly expose it to greater risk of fracture and other injury than if such brittle material as a thin shell of bone did not enter into its composition.

The operation practised by Ollier appears to me to be less happy than many of that excellent Surgeon's suggestions. It consists in cutting down the nasal process of the superior maxilla, and then bending it across so as to form a kind of bridge, on which to sustain the integumento-pericranial

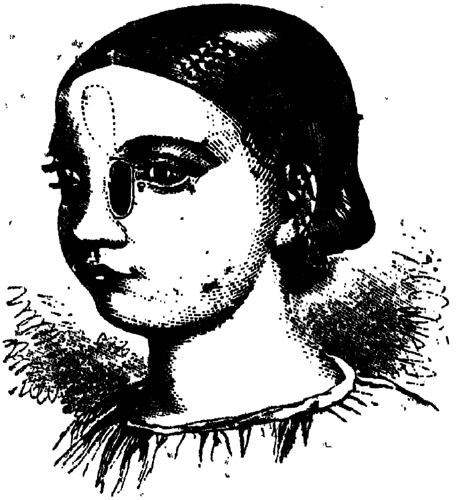

Fig. 599.—Opening into Anterior Nares.

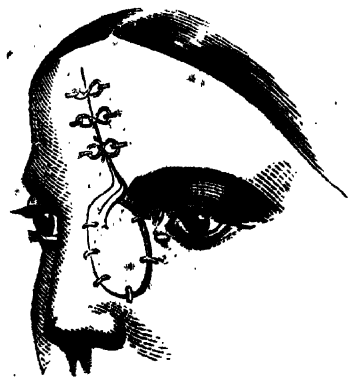

Fig. 600.—Opening into Anterior Nares closed by Operation.

flap deflected from the forehead. But by doing this the lateral supports to the bridge of the new nose are removed, and necrosis of the bent or rather broken fragment of bone, which has actually occurred, is not an unlikely accident.

FISTULOUS OPENINGS THROUGH THE NASAL BONES leading into the interior of the nostrils are occasionally met with. Such apertures as these are, perhaps, best closed by paring the edges, and then bringing forward a flap of neighbouring skin by the gliding operation. In some cases of this kind, procedures may be required, in which the Surgeon may display much ingenuity and benefit his patient greatly. The cuts represent a case many years since under my care, before and the day after operation, in which a large aperture into the side of the nose, resulting from necrosis of the left nasal bone consequent on scarlatina (Fig. 599), was successfully closed by a flap of skin taken from the forehead by the twisting process (Fig. 600). The patient, who was a child at the time of the operation, has since grown into a comely woman, presenting scarcely a trace of the operation.

OPERATION FOR DEPRESSED NOSE.—Sometimes the nose is depressed and flattened in consequence of the loss of the cartilages, vomer, and septum, though the external parts remain entire. Dieffenbach has proposed a plan for raising it by slitting it longitudinally into three pieces ; dissecting the lateral slips from the osseous attachments ; paring the edges to such an extent that they overlap, and stitching them together ; then bringing the whole organ forwards by pushing long hare-lip pins across its base, so as to elevate and narrow its attachments, which are brought more into the mesial line. Fergusson has improved this procedure by not slitting the nose down, but dissecting it away from the bones from within the nostril, and then pushing long steel-pointed silver needles across from cheek to cheek, and twisting their ends over perforated pieces of sole-leather, through which they had previously been passed, thus bringing the whole organ bodily forwards. The columna is next fashioned in the way which has already been described ; and the nose is completed.

## PLASTIC SURGERY OF THE LIP.

HARE-LIP.—By **hare-lip** is meant a congenital perpendicular fissure or fissures through the upper lip, the result of an **arrest** of development. The condition thus produced in man is, according to Geoffroy St. Hilaire, not analogous to what is met with in the hare, but to that which occurs in animals of a lower grade of organisation—in fishes. The arrest of development takes place at the outer border of the intermaxillary bones, and is usually associated with a certain amount of disunion or malformation at the line of junction between these and the superior maxillary bones. When the arrest of development takes place on one side only, the hare-lip is said to be **Single** (Fig. 601). In it the mesial side of the gap is usually rounded ; the outer edge is flattened ; and the frænum at the angle is long and subcutaneous. It most frequently, so far as I have observed, occurs upon the left side. Not unfrequently there is a fissure on each side of the mesial line ; and then the hare-lip is said to be **Double** (Figs. 602, 603). When double, the fissure is deeper on one side than on the other, and usually extends into the nostril, and is associated with cleft palate ; though sometimes it stops short of this. In these cases the nose is usually flattened and expanded, and between the fissures there is always a central or medium lobule, consisting of the intermaxillary bones in a rudimentary condition; to this a triangular labial nodule is commonly attached. In many cases this is pushed forwards, and tilted on its base, so that the alveolar border projects forwards. Sometimes the projection is so considerable that it is attached to the tip of the nose.

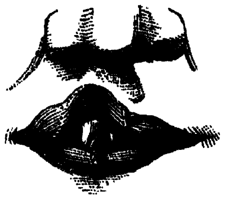
Fig. 601.—Single Hare-lip.

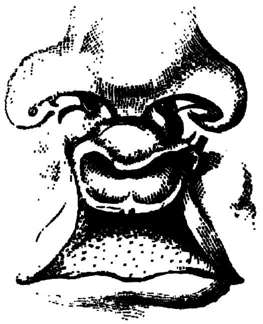
Fig. 602. —Ordinary Double Hare-lip.

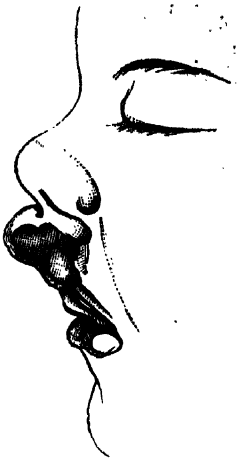
Fig. 603. —Ordinary Double Hare-lip. Side View.

**Median fissure** is so rare that there are scarcely any authentic cases of it in the records of surgery. Delahaye, however, mentions one instance of mesial fissure of the upper lip with two lateral fissures, and Nicati has described one in the lower lip, the only case of the kind that I have met with on record.

The cleft in hare-lip corresponds to the line of junction between the embryonic intermaxillary bones and the superior maxilla. The fissure, when single, may be confined to the lip; but in the majority of cases it extends to the alveolus of the upper jaw, giving rise to a deep notch between the outer incisor and the canine tooth. When it is double, the four incisors, usually imperfectly and irregularly developed, are included in the central intermaxillary tubercle. Meckel and Nicati have described a rare form of hare-lip, in which the fissure corresponds to the line of junction between the central and lateral incisors. In many cases the fissure extends back into the palate; this more frequently happens when the hare-lip is double, and in these cases every variety of palatal deformity is met with (Fig. 604).

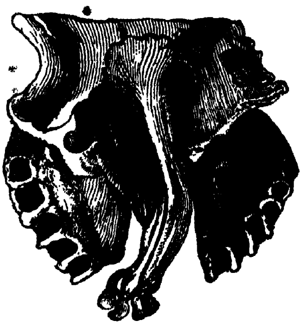
Fig. 604. —Skeleton of Jaw in Double Hare-lip, and Cleft Palate

**Age for Operation.**—The cure of hare-lip can only be effected by a properly conducted operation. In the performance of this, the first point that has to be determined is the age at which it should be done. On this there has been, and is still, a good deal of difference of opinion. Surgeons generally are, however, I think, agreed that it is better not to perform the operation during dentition; at all events not during the cutting of the incisor teeth, when there is much local excitement and general irritability of the nervous system; but they are not agreed as to whether it should be done before or after dentition. In support of the opinion that it is more prudent to wait until after this period, it is alleged that very young infants are especially liable to convulsions; that the performance of operations on them is troublesome; and that it interferes with suckling. These statements, however, are not carried out by what we meet [illegible] in practice. There is no evidence to show that there is any danger in operating during early infancy; on the contrary, very young children, those but a few weeks or months old, bear operations remarkably well. I have repeatedly operated at these tender ages, not only for hare-lip, but for hernia, the removal of tumours and nævi, the division of tendons, &c., and have never seen any bad result follow. Besides this, the performance of the operation is easier at a very early age than when the child has reached its first or second year; when, its intelligence being more developed, it knows what it has to suffer, and screams and struggles more than a very young infant does, whenever it sees the Surgeon, or when he makes an attempt to examine the wound or dressings. After the operation, also, the child will, when young, take to the breast without difficulty and with the greatest avidity. The act of suction is advantageous, as in it the sides of the incision are more closely compressed and brought together. At very early ages, union of the wound takes place with great readiness and solidity; and, as no time has been given for the rest of the features to become distorted, there will not be that permanent flattening and deformity of the face which is apt to continue after the hare-lip is cured, if the operation be deferred to a more advanced age. For these various reasons I agree with Dubois, Fergusson, and Butcher, that the operation had best be performed early; if possible, at about the sixth week after birth, or from that to the third month, which may, I think, be considered the time of election for this procedure. At this time the vitality of the child is good, and the tissues are not so lacerable as at an earlier age. The operation may safely be performed at a much earlier period in single than in double hare-lip; and the greater the deformity, the more marked the intermaxillary projection, the wiser will it be to defer operation, which not only becomes increasingly severe with the extent of the deformity, but after the performance of which the traction on the pins becomes too great for the tender tissues to sustain. Should circumstances require it, however, the operation might be done at a much earlier period than that advised above. Thus, at the urgent solicitations of the parents, I have performed it within the first twenty-four hours after birth, and several times during the first week. But in these very early days of life the operation is not without danger; the vitality of the child is often feeble, it suffers greatly from the loss of even a very small quantity of blood, and the tissues are so lacerable that there is great danger of the pins or stitches cutting out. I would therefore not advise its performance then.

It is scarcely necessary to observe that, as union by the first intention is aimed at, the operation should not be undertaken unless the health be good; and certainly not if the child, at whatever age, have but recently recovered from measles, scarlet fever, or other infantile disease.

**Operation for Hare-lip.**—In the treatment of hare-lip, there are three main objects to be kept in view: 1. The procuring of Union by the Direct Adhesion of the cut edges of the fissure; 2. The Prevention, as far as possible, of Deformity during the process of union; and, 3. The Avoidance of all Traction on the line of incision that may interfere with these results.

These principles of treatment are carried out by paring the edges of the fissure freely, bringing them together by means of the twisted or interrupted suture, and taking off all tension by means of strips of plaster and the cheek-compressor. But the details of the treatment vary so much, according as the fissure is single or double, or complicated by more or less projection of the intermaxillary portions, that the steps of each operation require to be separately described.

**Single Hare-lip.**—The operation for single hare-lip is performed in the following way. The child having been well pinned in a jack-towel that swathes it tightly, the Surgeon, sitting down, places his feet on a stool so as to raise them; and, covering his knees with a piece of tarpaulin, holds the child's head firmly between them. The bleeding from the coronary artery of the lip may be arrested, either by an assistant or the Surgeon grasping the lip between his forefinger and thumb, or by compressing the lip with the little contrivance here figured, which consists of an ordinary ring-forceps converted into a compressor by having a vulcanised India-rubber ring slipped over the handles. This little contrivance will be found to be invaluable in many operations about the face and jaws. The lower this ring is drawn down, the tighter will the forceps grip. The Surgeon first freely divides the frænum and all membranous connections between the angle of the cleft and the gum of the upper jaw, and then, putting the lip on the stretch by seizing the extreme edge of the cleft with a pair of artery-forceps or a tenaculum, he pares the edges of the cleft by transfixion with a narrow-bladed bistoury, or fine scalpel, from above downwards, first on one side, then on the other; taking care that the incisions unite neatly and cleanly above the upper angle of the fissure, which must be well cut out; and that they extend sufficiently far outwards to cut away the rounded portion of the prolabium which forms the side of the base of the fissure. Care should be taken that enough is cut away; there is more danger usually of taking too little than too much.

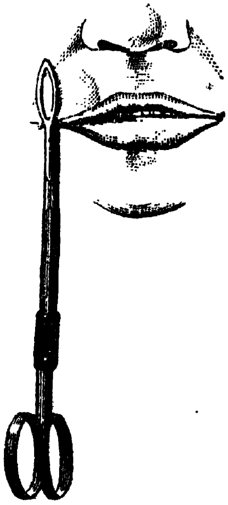
Fig. 605.—Elastic Compressor applied over Coronary Artery.

In single hare-lip, where the lips are very lax, the incisions may be straight; but if the gap be wide and the tissue deficient, or in double hare-lip, they should be somewhat concave inwards: in this way there is less likelihood of an unseemly notch being left (Fig. 608).

Fine hare-lip pins, made of soft iron wire, with steel points, should then be deeply introduced through the lip from one side of the fissure to the other. The pins should be entered at about a quarter of an inch from the pared edge on one side, and brought out at a corresponding point on the other; care being taken that, though they are passed deeply, the mucous membrane is not transfixed: if it be, it will be doubled into the wound, and thus interfere with union. Two pins are usually required; if the child be some years old, and the fissure very long, three may be used. The lower pin should be introduced first underneath or through the cut labial artery, in such a way that its pressure may stop the bleeding from this vessel, which is often rather free: in passing this pin, great care should be taken to bring the opposite sides of the fissure well into contact, so as to be on a level below, that no irregularity may be left in the prolabium. The twisted suture is then applied in the usual way (Fig. 606), first round the lower pin, and then round the upper one (separate threads, however, being used for each); and lastly, the two are united by a few cross turns, so as to press down and support the whole length of the fissure (Fig. 607). In applying the twisted suture the Surgeon must be careful, whilst drawing the edges closely into apposition, not to apply the threads too tightly, lest sloughing result; and in crossing them from one pin to the other, great caution must be used not to draw the two pins together horizontally, lest puckering of the line of union take place. The pins are then cut short, the whole is coated with a layer of collodion, and a piece of plaster is put under the ends of the pins to prevent excoriation of the skin. In addition to the pins and twisted suture, I invariably introduce one point of interrupted suture through the mucous membrane of the lower part of the fissure, just inside the mouth; and I look upon this as of great consequence in order to prevent the notching, which is otherwise very apt to occur, in consequence of that portion of the incision between the lower pin and the edge of the lip being kept open by the child in sucking, or protruding its tongue against it. At the end of from 72 to 96 hours, according to the age of the child, the pin should be withdrawn, or it may be removed by pushing it through the lip by a gentle rotatory movement, in such a way that the cut end does not tear or lacerate the aperture in the lip. The threads, matted together with exudation and a little blood, form a good crust, which may be left on for two or three days longer, and then allowed to separate of itself; the less any crusts that form over the line of incision are interfered with, the better will usually be the result. The lip may, if thought desirable, be supported by a strip of adhesive plaster, which should, indeed, be continued for about a fortnight after the operation, so as to prevent stretching of the cicatrix and notching of its lower part. The point of interrupted suture may be left in for about four days. It sometimes, though rarely, happens in single hare-lip that the intermaxillary portion is so large and projecting, that there is difficulty in bringing the lateral segments together over it. Should this be the case, the better plan is to notch it at its alveolar border on the side that is not fissured, and then to break it back so as to remove all projection. If the fissure be wide, and the child restless, so that there is danger of the parts being dragged upon during its screaming or crying, it is a very good plan to apply the spring cheek-com-

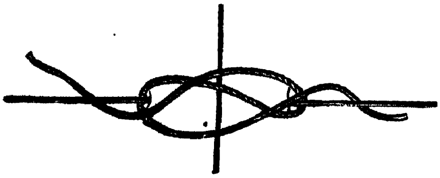

Fig. 606.—Application of Twisted Suture.

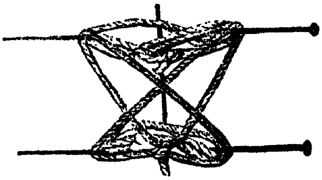

Fig. 607.—Application of Pins and Sutures in Hare-lip.

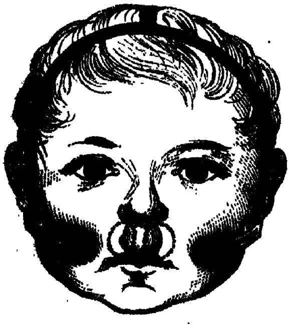

Fig. 608.—Hare-lip: Spring Cheek-compressor.

pressor, invented by Hainsby, here represented slack (Fig. 608). Indeed, whenever obtainable, this excellent contrivance should be employed. Its use adds greatly to the success of the operation.

**Double Hare-lip.**—The operation for double hare-lip is performed on the same principle as that for the single form of the disease, viz., of procuring union by adhesion between the opposite surfaces. The difference in the operations consists chiefly in dealing with the intermediate portion of the lip and alveolus (Fig. 609). The management of the intermaxillary process must vary according to its size and degree of projection. If it be small and rudimentary, or fixed to the tip of the nose, as in Fig. 610, it should be cut off with bone-nippers, as it would prevent the lateral segments from coming into proper apposition. Most commonly, when this is done, there is free and even dangerous bleeding from a dental artery deep in the bone, which may require to be touched with a red-hot needle or wire before the hæmorrhage from it will cease. If the central intermaxillary portion be large and projecting, it may be bent or broken back by strong forceps covered with vulcanised India-rubber. Fergusson has, however, pointed out that if this be done the incisor teeth contained in the intermaxillary portion will, if they develope at all, project backwards into the roof of the mouth, as the bone is not pushed into its normal situation, but rather rotated on its transverse axis, the slender neck attaching it to the vomer being bent upon itself. He is of opinion therefore that in all cases it is better to remove the bone than to attempt to force or bend it into a new position. If it be large and not projecting, the soft parts should be well pared on each side, and transfixed by the hare-lip pins, and thus be interposed between and united to the pared lateral surfaces; indeed, it is always advisable not to remove this, unless it be awkwardly situated, as in Fig. 611. When it is left, though the union may not appear quite so perfect

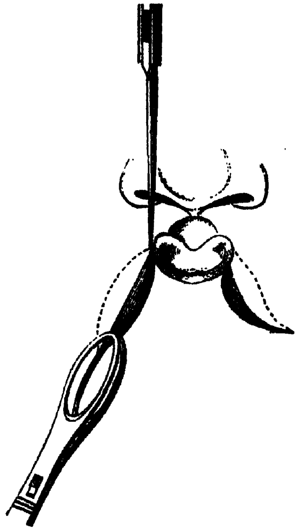

Fig. 609. — Operation for Double Hare-lip. Right side of Lip drawn down by Spring-hook Forceps; long narrow Knife entered at angle: dotted line shows direction of the Incisions.

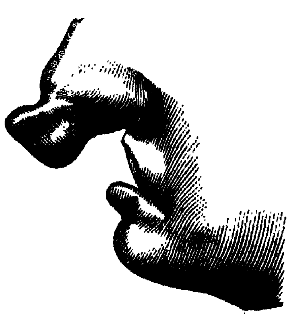

Fig. 610. — Double Hare-lip: Intermaxillary Portion fixed to Nose.

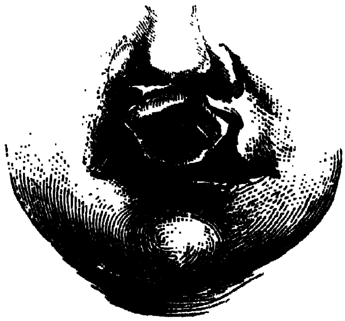

Fig. 611.—Double Hare-lip: Projecting Intermaxillary Portion.

and uniform as it would if the lateral halves had been directly united, yet eventually the case will turn out better; the central portion becoming developed, and forming the natural mesial projection of the lip, which is lost when the lateral halves are directly united. Butcher has invented some very simple and ingenious forceps for the partial section and bending back of the intermaxillary process. In some of these cases great nicety is required in planning the incisions, and in the introduction of the sutures. The central portion is most advantageously pared in a somewhat concave manner, so that the freshly cut edges of the lateral halves are received into and more accurately fitted upon it. Should, as often happens in single as well as in double hare-lip, one of the lateral segments be tied down to the gum and alveolus by a doubling of mucous membrane, this must be freely divided, and the portion of lip, with perhaps the corresponding ala of the nose, freely dissected up from the osseous structures, so as to admit of its being moved forwards without too much traction being put upon it.

In those cases in which the intermaxillary portion is projecting, and attached to and fused with the columna of the nose, as in Figs. 610 and 611, I have performed the following operation with great success.

1. The triangular flap of skin covering the intermaxillary portion is dissected up as thick as possible. 2. The intermaxillary process is then cut away at its root, which is small and pedunculated, with a pair of scissors. 3. The edges of the lateral fissures are then pared in the usual way. 4. The free lower margins of the pared edges are brought together by one hare-lip pin and twisted suture. 5. The leaf-shaped flap is then laid down in the triangular hollow left above the pin, and retained there by one or two points of silver suture on each side, the gap being thus completely filled up by it.

**Treatment by Simple Suture.**—During several years I was in the habit of treating hare-lip of all kinds, double as well as single, with the simple interrupted suture alone, without using any pins. I have in this way treated most successfully many cases in children, whose ages have varied from a few days to four years, with most satisfactory results, and with less marking of the lip than I have ever seen attend union by means of the twisted suture. I prefer the simple to the twisted suture as being equally safe, more simple, and followed by less scarring of the lip, provided the case be not too complicated, nor associated with very wide fissure in the palate, or with great projection of the intermaxillary bones. In these circumstances, the pins should be preferred.

When the fissure is single, the edges, having been pared in the usual way, should be brought together by two points of suture; the first passed deeply near the free edge, and in such a way as to compress the cut coronary artery; the other nearer the nasal angle. These sutures should be of thick well-waxed dentist's twist that will not cut out too readily, or, what is better, of silver wire. A point of fine interrupted suture should then be inserted through the mucous membrane inside the lip. The tip may then be supported by two narrow strips of plaster, one placed between the sutures, the other between the upper suture and the nose. On the third day the upper suture should be taken out, but the lower one may be left in for a day or two longer, when it and the one through the mucous membrane may be removed together, unless the latter have already cut its way out. If silver wire sutures be used, they may be left in for six or seven days without producing irritation. The lip must then be supported for a few days with a strip of plaster.

In the case of double hare-lip the same plan is to be adopted, first on one side, then on the other; but here, as the gaps are wider, and the tension, more particularly when the intermaxillary prominence is very projecting, is apt to be considerable, it is necessary to support the cheeks, and thus to prevent undue traction on the stitches, by means of the cheek-compressor (Fig. 607). In this way all risk of the stitches cutting out before union is completed is avoided; an excellent and solid union will speedily be obtained even in cases of double hare-lip, with some intermaxillary projection and fissured palate.

The operation occasionally fails. The probability of the occurrence of such an untoward event is, however, greatly diminished by the use of the cheek-compressor. It may, however, happen either in consequence of the child's health being in an unsatisfactory state, so as to prevent union by the first intention; or in consequence of the pins having been withdrawn too early, before secure cohesion has been effected. In such circumstances as these, an attempt might be made to unite the granulating edges by the re-introduction of the pins or sutures, and by firmly fixing the lip by means of the cheek-compressor. Such attempts, however, rarely succeed; should they not do so, it will usually be found most prudent to wait at least a month before taking any further steps, and then to pare the edges afresh and repeat the original operation.

Congenital Transverse Fissures of the Cheeks, extending from the angle of the mouth to the anterior border of the masseter or up towards the malar bone, are occasionally met with, and have been specially described by Klein and Nicati. In these malformations, which are of extremely rare occurrence, the ear on the affected side is imperfectly developed. As has been observed by Fergusson, the tragus is detached from the auricle, and is fixed to the cheek, where it forms a small lobulated appendage. This external ear generally is malformed, the helix being twisted and curled inwards. These malformations require to be treated on exactly the same principles, and with the same attention to details, as hare-lip; union between the pared edges being effected by means of hare-lip pins and the twisted suture.

Cheiloplasty.—Simple plastic operations are commonly practised on the lower lip for the removal of cancroid disease, by cutting out a V-shaped piece of the lip, including the whole diseased structure, and then bringing together the opposite sides of the incision by hare-lip pins. These operations have already been described and figured at p. 400, Vol. II. We shall consider here those cases in which it becomes necessary to repair more or less extensive loss of substance in the labial structures. The restoration of a portion of the lip that has been destroyed by accident or disease, is not so readily effected as that of the nose; yet a good deal may be done to remove the deformity. The plan originally introduced by Chopart consists, when it is the lower lip that is deformed, in carrying an incision from behind the lower jaw down to the hyoid bone, so that a square flap may result, which is detached from above downwards. This flap is then brought up, and fixed to the pared edges of the remaining portion of the lip by points of suture; the head being kept properly inclined, in order to prevent undue tension. After sufficient union has taken place to preserve the vitality of the flap, its lower attachment may be divided. The flap should, if possible, not be twisted, though it is not always practicable to avoid this. This operation is not usually very satisfactory in its results, as the new flap is apt to become œdematous and inverted at the edge, or the flow of saliva may interfere with proper union. In those cases in which the greater portion of the lower lip has been excised for cancerous disease affecting its upper margin, the most successful procedure for the restoration of the deformity consists in a modification of the plan recommended by Serres; and from this I have derived excellent results, as in the case which is here represented (Fig. 612). The object of the operation is to raise the lower lip to a level with the incisor teeth. An incision, about three-quarters of an inch in length, is made directly outwards from the angle of the mouth, on each side, into the cheek; from the extremity of this, a cut is carried obliquely downwards on to the upper margin of the lower lip, so as to excise the included triangular piece; the lower lip is then dissected away from the jaw, from the inside of the mouth, and a V-shaped piece is taken out of its centre. By means of a hare-lip pin on each side, and a point of suture, the incisions in the angle of the mouth are brought accurately together; and in the same way the vertical one, in the centre, is united (Fig. 613). In this way the whole of the lower lip is raised, and brought more forwards. If care have been taken in removing the cancer from the edge of the lip, to leave the mucous membrane rather long (which may always be done, as the skin is affected to a greater extent than it), a good prolabium may be formed, and the restoration effected with but little deformity. Care must be taken to prevent union from occurring between the inside of the lower lip and the gum, by the interposition of a strip of oiled lint.

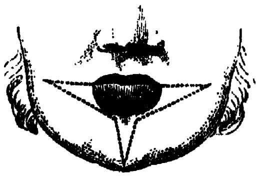

Fig. 612.—Lines of Incision in Cheiloplasty.

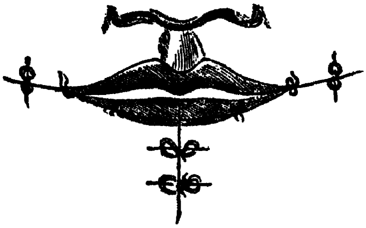

Fig. 613.—Incisions and Sutures in Cheiloplasty.

Buchanan, of Glasgow, as far back as 1841, published an account of a method for restoring the lower lip when affected by extensive cancerous disease, which leaves most satisfactory results. The accompanying figures illustrate the kind of case in which Buchanan's operation is applicable, the lines of incision required, and the appearance presented by the chin and lip after the disease has been removed, and the flaps brought into proper apposition.

The steps of the operation are simple, and the result is excellent.

The diseased part of the lower lip is first removed by an elliptical incision (Fig. 614, A B A). An incision, B C, is then carried downwards and outwards on each side of the chin ; and another incision, C D, upwards and outwards parallel to, and corresponding in length to, A B. The flaps formed by these incisions are represented in Fig. 615. They are detached from their subjacent connections ; and the whole is raised upwards, so that the original elliptical incision comes into a horizontal line, and is made to constitute the margin of the new lip ; the secondary incisions under the jaw coming together in a vertical direction, in which they are retained by twisted and interrupted sutures (Fig. 616).

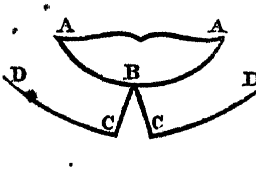

Fig. 614.

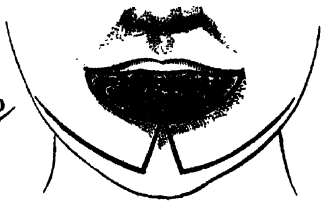

Fig. 615.

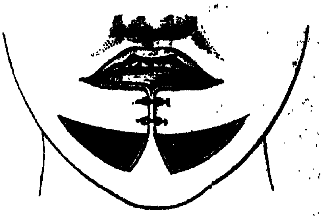

Fig. 616.

Buchanan's Operation for the Restoration of the Lower Lip.

Syme recommended a somewhat different mode of operating. Instead of making the incisions C D, he carried those marked B C onwards for some distance in a direction curving downwards and outwards, so that they terminated below the angles of the jaw. The flaps so formed were raised and united in the middle line, as in Buchanan's operation, the Λ-shaped portion of skin above the chin serving to maintain them in position and prevent their sliding downwards. The long curved incisions enabled this to be done by merely stretching the convex edges of the flaps, without sufficiently displacing them to prevent their readily meeting the concave edges of intervening skin, and being united to them by sutures. No surface was therefore left to granulate, and the whole wound has healed by the first intention.

## PLASTIC SURGERY OF THE PALATE.

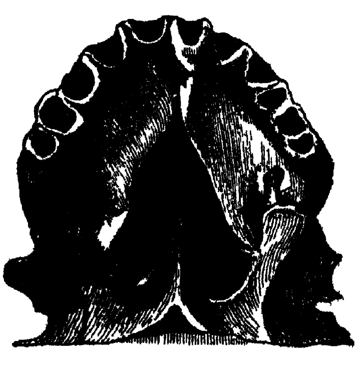

Fig 617.—Fissure of Hard and Soft Palate.

Various degrees of congenital deformity may occur in the palate and uvula : thus the uvula alone may be bifid, or the cleft may extend through the greater part of the whole of the soft palate ; or the hard palate may be divided as well (Fig. 617) ; and, lastly, the separation may extend forwards to the integuments of the face, producing single or double hare-lip (Fig. 604). The soft palate and uvula are not unfrequently cleft without the hard palate being divided ; and, in some very rare cases, the lip and the hard palate fissured without the soft one being cleft.

These malformations necessarily give rise to great inconvenience, by interfering with deglutition, and rendering speech nasal and imperfect. During the swallowing of fluids, there is a tendency to regurgitation through the nose, though this is occasionally prevented by the approximation of the edges of the fissure in the soft palate.

Until a few years ago, the operation was always deferred until the patient had attained the age to understand the necessity of remaining quiet during the proceeding, and was able to control his movements, as success depended in a great measure upon his remaining perfectly tranquil and steady during the necessary manipulations, which are of a tedious and protracted character; and upon his assisting the Surgeon by opening his mouth, and not struggling during the introduction of instruments. Chloroform was never administered, from the fear that suffocation might be caused by the blood from the operation, which is always abundant, entering the air-passages. In 1869, however, Thomas Smith, of St. Bartholomew's Hospital, demonstrated that with proper care anæsthetics may be safely administered, and at the same time he invented a most ingenious gag, by means of which the patient's mouth can be kept widely open without the Surgeon being interfered with either by the hands of assistants or the instrument itself. By the help of this gag, and the administration of chloroform, the operation can now be performed at any age; but as the bleeding is always very free, it is advisable not to attempt it in too young children. At the age of three it may be safely undertaken, and the advantage of having it done before the child has learned to speak is very great.

STAPHYLORAPHY.—The operation for the cure of a cleft in the soft palate may be said to have been introduced by Roux; for although several attempts at the cure of this deformity had been made by Surgeons before his time, yet he was the first to establish **Staphyloraphy** as a distinct operation. Many modifications of Roux's plan have been practised by Von Gräfe, Warren, Dieffenbach, Liston, and others, in order to render it more easy of execution, and certain in its results, and especially by making incisions through the palate so as to take off the traction on the sutures; but to Fergusson is due the great merit of introducing a new principle of treatment in the operation—viz., the application of myotomy to it, thus paralysing the movements of the muscles of the palate. Fergusson found that the great cause of failure in these operations was the mobility of the parts, and the traction exercised by the muscles, principally the levator palati and the palato-pharyngeus, on the line of union; in order to obviate this, he conceived the happy idea of dividing these muscles. Before Fergusson laid down the principles of this operation, it is true that various cuts had been made in the palate by different Surgeons, with the view of taking off the tension after the sutures were tied. Thus Dieffenbach, Pancoast, Liston, and Sédillot, all recommend that the traction on the stitches should be lessened by longitudinal or transverse incisions across the velum pendulum palati. Mettauer practised several small incisions for this purpose; and Mason Warren divided the anterior pillar of the fauces and its attachments to the posterior pillar, coming nearer than any previous operator to Fergusson's method. These operations, however, were done almost at hap-hazard, and in an empirical way, without the recognition of any distinct principle being involved in them.

**Operation.**—The patient is placed in the recumbent position, the Surgeon standing on his right side. The gag is then inserted, and chloroform administered, or if the patient be nervous the gag may be inserted when anæsthesia is induced. The gag represented in the accompanying drawing (Fig. 618) is a modification of Smith's, invented by Wood. It can be adjusted to fit any patient by more or less widely separating the two halves.

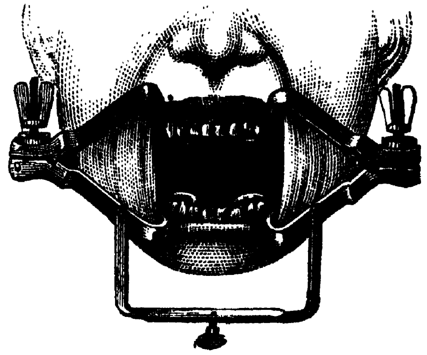

Fig. 618.—Wood's Modification of Smith's Gag.

In the operation as performed by Fergusson, there are four distinct stages. 1. The *muscles of the palate are divided*, by passing a curved lancet-ended knife through the fissure behind the velum, midway between its attachment to the hard palate and the free margin, and about half-way between the velum and the end of the Eustachian tube. By cutting deeply with the point of the knife in this situation, the levator palati is divided. The uvula is then seized and drawn forwards, so as to put the posterior pillar of the fauces on the stretch, which is to be snipped across, so as to divide the palato-pharyngeus. The anterior pillar, the palato-glossus, may then be notched in a similar way. 2. The next step in the operation consists in *paring the edges of the fissure from above downwards*, by means of a sharp-pointed bistoury. This is best done by seizing the lower end of the uvula, putting it on the stretch, and cutting first on one side and then on the other, leaving the angle of union to be afterwards removed. The patient should then be allowed to remain quiet, and to gargle the mouth with cold water or to suck ice, so as to stop the bleeding; or, if under chloroform, a piece of ice fixed in a holder may be applied to the wound to check the hæmorrhage, while the fauces are frequently cleared of blood and mucus by means of sponges on sponge-holders. 3. When the bleeding is arrested, the Surgeon proceeds to the next step, that of *introducing the sutures*; this may be done by means of a nævus-needle, armed with a moderate-sized thread, being passed from below upwards on the left side of the fissure, about a quarter of an inch from the margin ; the thread should now be seized with forceps, and one end of it pulled forwards through the fissure. This may again be threaded in the needle, and passed through the opposite side of the fissure from behind forwards through the right side ; as the point of the needle appears, the thread should again be seized, and the needle at the same time withdrawn ; the suture is then tied by means of the Surgeon's knot ; and in this way, according to the extent of the fissure, from two to four sutures may be passed and tied lightly, and the knots cut close. An important improvement in this method of passing the sutures is now very generally adopted. It consists in passing a single suture through the left side of the cleft from before backwards in the usual way. A needle, having an eye at its point, and threaded with a *loop* instead of a single thread, is now passed through the right side of the cleft, the loop drawn through, and the needle removed. The single suture is then slipped through the loop. This is then withdrawn, carrying with it through both sides of the cleft the single ligature. In this way the sutures, being passed on both sides from before backwards, can be inserted more evenly, and with less chance of puckering when knotted. In tying the knots, great care should be taken that no undue traction be exercised upon the parts; in fact, the use of the sutures is not to draw, but simply to *hold*, the parts together; the division of the muscles has caused these to be relaxed, so that they hang down loosely, and merely require to be held in apposition by the sutures. The patient must next be put to bed, and every care taken to avoid any movement of the palate. He should be restricted to fluid but nourishing food for a few days, and should be directed to swallow this with as little effort as possible, and indeed should not be allowed anything solid until complete union has taken place. All coughing, spitting, or swallowing of the saliva should be interdicted. 4. *The stitches should be left in for several days;* and, indeed, need not be disturbed so long as they produce no irritation. They usually require removal by the eighth or tenth day, but occasionally may be left with advantage for some time longer, until they excite irritation, or until union is perfect; they should then be cut across with scissors and drawn out, the upper one first, the middle next, and the lower one last. Should there be any aperture left in the palate, where union has not taken place, this may be closed by touching it with a point of nitrate of silver.

The voice in these cases does not usually at once recover its natural tone after the operation, although in some cases it may. The nasal or "Punch-like" voice that is often left after operations, appears to arise from two causes. The first is the mere habit of faulty articulation, and this can be corrected by careful instruction in elocution. The second, which is much more difficult to deal with, arises from a mechanical condition, and is dependent on the contraction upwards of the palate along the line of the cicatrix, so that the velum becomes unable to shut off the posterior nares from the pharynx. Mason has proposed to remedy this condition by dividing the soft palate perpendicularly on each side, so as to leave a square and mobile central flap.

In dividing the levator palati, Pollock adopts a different practice from that of Fergusson. Instead of cutting from behind, he passes a ligature through the curtain of the soft palate so as to control it and draw it forwards; then,

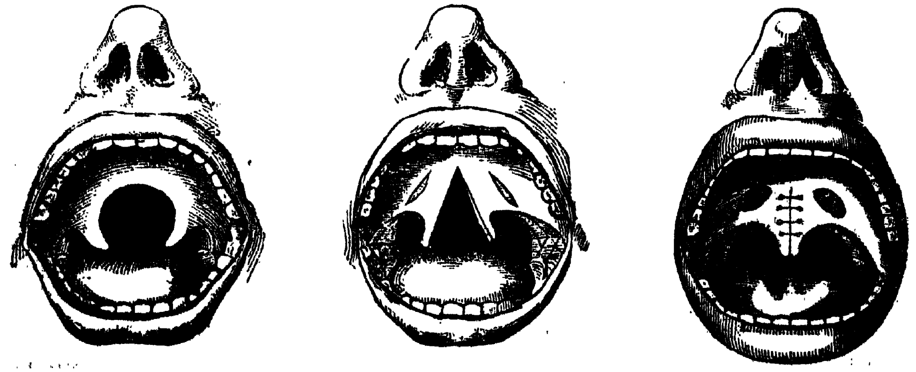
Fig. 619. Fig 620. Fig 621.

Sédillot's Operation for Staphyloraphy

pushing a narrow-bladed knife through the soft palate to the inner side of the hamular process, he readily divides the muscular fibres by raising the handle and depressing the point. This method of dividing the levator palati, which is analogous to the plan employed and depicted by Sédillot (Figs. 619, 620, 621), appears to be more simple and easy of execution than the division of the muscles of the velum from behind. The gap that is left closes without difficulty by granulation, and seems still more to take off tension from the parts.

URANOPLASTY.—**Fissures of the Hard Palate** are usually closed by means of "obturators" made of gold, vulcanised India-rubber, or ivory. To Warren, of Boston, is undoubtedly due the merit of having been the first to close these fissures by a surgical operation. This he did by dissecting the soft tissues from the palatal arch between the margin of the cleft and the edge of the gum, and then uniting them in the middle line by means of stitches in the same way as in fissured soft palate. This operation was first brought before the Profession in this country by Avery and subsequently by Pollock, who have invented some very ingenious instruments for its proper performance.

The operation is performed in the following way. An incision having been made along the edge of the cleft, at the junction of the nasal and palatal mucous membranes, the soft covering of the hard palate is carefully dissected or scraped down off the bones by means of curved knives, great care being taken that the mucous membrane and its subjacent fibro-cellular tissue, which varies great in thickness in different cases, be not perforated. Langenbeck has particularly recommended that the periosteum be detached with the fibro-mucous tissue; so that the flaps brought down may not only be thicker and stronger than they otherwise might be, but also that they may eventually throw out bone and thus close the gap by a firm solid deposit. In doing this, Langenbeck uses a blunt instrument in preference to a sharp angular one, and takes especial care to avoid the division of the attachments of the soft covering of the hard palate, at those points, anteriorly and posteriorly, where the blood-vessels and nerves enter. When these structures have been well loosened on each side, the covering of the palate will be found to hang down as a curtain from the vault of the mouth—the two parts coming into apposition along the mesial line, or possibly overlapping. The edges, being then smoothly pared, are brought into apposition by means of a few points of suture, thread or wire, the latter preferable, introduced in the ordinary way and without any dragging. On this point great care is necessary. The knots having been tied, the patient is confined to bed for several days, and allowed an abundant, but fluid or pulpy diet. Union, if it take place, will usually be found to be perfect at the end of a week.

Sir William Fergusson, not having found the operation above described as successful as was at first hoped, was led to devise a different method, which in his hands has proved most satisfactory. Instead of raising the soft structures of the hard palate from the bone, he makes an incision on each side of the fissure, and then dividing the bone longitudinally with a chisel, forces the two edges into contact. The operation is thus performed. The patient being under the influence of chloroform, and Smith's or Wood's gag having been introduced, the edges of the fissure in the hard palate are pared. An incision is then made down to the bone on each side, a quarter of an inch from the margin of the fissure and parallel to it. The chisel is then carefully pushed upwards through the bone into the cavity of the nose. By a slight lateral movement of the chisel, the two portions can now be readily made to meet in the middle line; stitches may then be passed through the opening on each side; the lateral gaps close afterwards by granulation. As Sir William Fergusson found that the stitches when passed through the two lateral wounds were apt to slip, in his later operations he drilled the palate on each side of the fissure in one or more places, and passed the sutures through the drill-holes before applying the chisel; and, still more lately, he has in some cases abandoned sutures altogether, and kept the two sides of the fissure in contact by introducing plugs of lint into the lateral wounds. In a few cases slight necrosis has occurred after this operation, but in none has there been any difficulty in closing the two lateral gaps formed by the chisel. In order to be successful, a careful selection of cases to be operated on must be made. Fergusson considers that about one-half of the fissures of the hard palate admit of operation.

There is a difference of practice amongst Surgeons as to the closure of the gap in the soft palate at the same time as the one in the hard palate, or at a subsequent period. Pollock prefers a delay in the operation until the cleft in the hard palate is closed. Annandale has, however, operated successfully by closing the fissure in both palates at one sitting; and perhaps the wisest course to adopt is to close as much of both as the patient can bear at one time, and to leave the remainder of the operation to be completed at another opportunity. If it be determined to undertake the closure of the hard and soft palates in two distinct operations, Fergusson prefers to do the soft palate first, leaving the hard till a later time.

PERFORATION OF THE HARD PALATE.—Perforations of the hard palate, consequent on necrosis of the bones, the result of syphilis or injury, are not amenable to surgical treatment. In such cases, a well fitting obturator will most effectually remedy the inconvenience.

TUMOURS OF THE PALATE.—Tumours of various kinds may arise in the hard or soft palate. Amongst the most important are Enchondroma, Fibroma, and Sarcoma of the hard palate, and Adenoma of the soft palate. These last are, perhaps, the most frequent. They are occasionally found also in the hard palate. They are hard, smooth, painless, and, being encapsuled, are readily shelled out from a single incision. Syphilitic gummata and cancer may also occur in this region. The diagnosis must be made and the treatment conducted on general principles.

# CHAPTER LIX.

## DISEASES OF THE MOUTH AND THROAT.

### DISEASES OF THE TONGUE.

TONGUE-TIE.—Infants and even adults are said to be *tongue-tied*, when the frænum linguæ is shorter than usual, causing the end of the tongue to be slightly bifid, depressed, and fixed, so that it cannot be protruded beyond the incisors. If this malformation be considerable, suckling and distinct articulation may be interfered with; and then division of the fold becomes necessary, which may readily be done by snipping it across with a pair of round-ended scissors. In this operation, the risk of wounding the ranine arteries, that is sometimes spoken of, may be avoided by keeping the point of the scissors downwards towards the floor of the mouth.

HYPERTROPHY AND PROLAPSUS OF THE TONGUE has occasionally been met with, either as a congenital or an acquired condition; it has been described by Lassus and Crosse as consisting either in want of power in the retractor muscles, or in hypertrophy of the organ (Fig. 622). In this condition, the tongue lolls out of the mouth, is greatly swollen, of a purplish colour, but somewhat dry, with constant dribbling of saliva. If the swelling have existed for a long time, it may give rise to deformity of the teeth, and of the alveolus of the lower jaw, which is pushed forwards. In the *Treatment* of this affection, little need be done unless it be excessive and permanent, when excision of a portion of the tongue by the écraseur may be required.

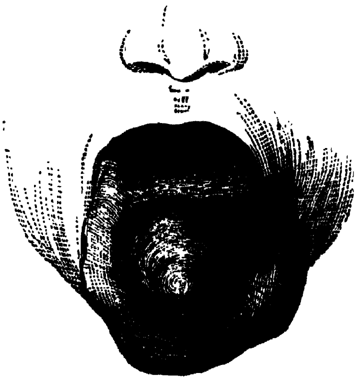
Fig. 622.—Great Hypertrophy of Tongue.

GLOSSITIS is a rare affection, more particularly when it occurs idiopathically; most commonly it results from immoderate and injudicious salivation. In this disease the tongue is greatly infiltrated with serum and blood, becoming immensely swollen, so as to hang out of the mouth, with profuse discharge of saliva and inability on the part of the patient to swallow or speak, and perhaps a threatening of suffocation.

The *Treatment* is as simple as it is efficient; it consists in making a long and free incision along the dorsum of the tongue on each side of the raphe, which gives free and immediate relief by the escape of blood and infiltrated fluids. I have seen a patient, who was nearly suffocated by the immense size of his tongue, relieved at once by such incisions, and nearly well in the course of a few hours afterwards.

Abscess of the Tongue, though rare, occasionally occurs. I have seen several instances of it. The abscess forms a small deeply seated elastic but firm tumour, which sometimes feels slightly movable and presents no superficial discoloration. A boy was once brought to me with an elastic tumour of slow growth, and of about the size of a small plum, situated deeply in the centre of the tongue; on puncturing it, about half an ounce of healthy pus was let out, after which the cyst speedily closed.

Nævus and Aneurism by Anastomosis are but rarely seen in the tongue, and when met with would require to be treated on the same principles that guide us in the management of the disease elsewhere. A very remarkable instance of an erectile tumour of nævoid character affecting the tongue came under my care, in which the whole of the free extremity of the organ was implicated in the morbid growth, presenting a thin club-shaped end, which protruded between the teeth and lips of the patient, a girl about three years old. In this case Image, of Bury St. Edmunds, had very judiciously arrested the activity of the disease, and had produced consolidation of the mass, by the introduction of setons, which were worn for some months; and, when the child subsequently came under my care, the chief inconvenience that existed resulted from interference with speech, and the deformity occasioned by the hypertrophied and elongated organ (Fig. 342, p. 942, vol. I.) By means of the écraseur I removed all the redundant tissues, and so reduced the tongue to its normal length and breadth.

Morbid Changes of the Epithelium of the tongue sometimes occur; amongst the most remarkable of these is **Psoriasis.** In this affection the tongue is indurated, shrivelled, and dry, having cracks upon its surface, with patches of a dead white colour, and irregular in shape, varying in size from that of a split-pea to an inch in diameter; this condition exactly resembling psoriasis of the palms of the hands, may occur with or without scaly disease of the general integument. I have seen it in both conditions, and have always found it a most difficult affection to treat. The preparations of arsenic, with Plummer's pill and sarsaparilla, have, however, appeared to afford the best results. In some instances it is evidently of syphilitic origin: and then it requires to be treated on the general principles that guide us in the management of the constitutional forms of that disease.

The surface of the tongue occasionally assumes a **Glazed and Warty Character,** as if covered with a layer of boiled sago; the mucous membrane being œdematous, elevated and papillated, but at the same time glassy and semi-transparent, and without induration. This condition, which usually arises from syphilis, requires the constitutional treatment of that disease.

A **Hard Warty Condition of the Mucous Membrane** covering the end or side of the tongue is occasionally met with, giving rise sometimes to so much interference with speech, as to require removal either by the scissors or écraseur. This has been likened by some to **Ichthyosis,** and appears to consist of an elongation of the papillæ with a dense horny epithelial covering to them. Both it and the disease which I have described as psoriasis are liable to degenerate into epithelioma of the organ, and they thus acquire a serious and prospective importance.

Fissures or Cracks not uncommonly appear upon the side of the tongue, usually opposite the molar teeth, sometimes dependent on irritation of stumps, but not unfrequently on dyspepsia. These cracks may in some depraved states of the constitution extend rapidly, eroding away a considerable portion of the side of the organ in a short time, so as to leave a large and deep sloughy cavity with much dusky inflammation around it, but without any induration of the base or sides, with great fetor of the breath, and a copious discharge of saliva, which trickles out of the corners of the mouth; the patient being usually destroyed in a few months, by the irritation of the disease, the inability to take food, and the supervention of hæmorrhage.

*Treatment.*—This disease, which is a combination of sloughing and ulceration, possibly in some cases malignant, is best treated in the early stages by the use of chlorinated gargles, with a moderately anti-inflammatory regimen. As it advances, the internal administration of arsenic is useful in some cases, with the application of the balsam of Peru, either pure or diluted with the yolk of egg, and the employment of gargles composed of the chlorides and the tincture of myrrh.

SYPHILITIC GUMMA is not unfrequently met with in the tongue, as one of the advanced symptoms of constitutional syphilis, forming an indurated irregularly circumscribed mass, of a round shape, situated deeply in the substance of the organ, or towards the centre of the tip. The surface covering the gumma is of a dusky red or coppery colour; it rarely runs on to ulceration, though rhagades and fissures occasionally form around it; there is no fetid discharge, and no destruction of the organ.

The *Treatment* consists in the administration of small doses of bichloride of mercury in sarsaparilla, under which the gumma will rapidly disappear.

ENCYSTED AND FIBROUS TUMOURS, requiring extirpation, are sometimes situated in the centre of the tongue, towards its mesial line. In such cases they may readily be removed by drawing the tongue forwards by means of a hook or piece of whipcord passed through its tip, and then dissecting out the morbid growth. Any bleeding that occurs may be arrested by passing a suture or two by means of a curved or cork-screw needle across the gap in the course of the divided vessels, and thus closing the aperture at the same time that the vessels are compressed.

CANCER OF THE TONGUE.—**Epithelioma** is the form of cancer that commonly affects the tongue. It almost always commences on the edge, usually at the middle third, extending back to the anterior pillar of the fauces. It may occur at the tip, or even on the dorsum of the tongue.

*Scirrhus* is rare. I have, however, seen it in several instances, and after death scirrhus tubercles have been found in the liver, lungs, and heart. Scirrhus commonly begins as a hard solid mass in the body of the organ. I have only seen *encephaloid* when the disease was recurrent, and then in the floor of the mouth.

Cancer of the tongue, whatever form it assumes, most usually occurs in individuals between the ages of forty and sixty. It is more frequent in men than in women. It may develope without any evident cause in persons who are otherwise perfectly healthy, whose teeth are sound, and in whom there has been no pre-existing disease of the tongue. But most commonly it occurs in consequence of a local irritation, as from the abrasion produced and kept up by a broken tooth. Or it may gradually develope in the site of an old syphilitic crack or unhealed fissure. In some instances I have seen it preceded for some years by chronic thickening, apparently of a squamous character, of the mucous membrane of the tongue, which slowly hardens, ulcerates, and at length becomes epitheliomatous at one part. Most generally, the posterior lateral aspect of the tongue is the one thus affected. If a tubercle or warty growth appear, this is usually flat, indurated, and of a purplish-red colour, gradually running into ulceration; if a fissure, this from the commencement has an indurated base, a foul surface, and a callous edge. As the ulceration extends, a chasm with ragged sides, and a sloughy surface that cannot be cleansed, gradually form over a widely indurated base; there are great fetor of the breath, and profuse salivation; and, as the disease progresses, implication of the mucous membrane and of the structures of the floor of the mouth, and of the glands under the jaw and in the neck, takes place. Sometimes the whole mass of the organ is infiltrated by cancerous deposit, becoming generally hard, nodulated, ulcerated, and in some parts covered by thin red cicatrices, and in others by foul putty-like accumulations of epithelium. The pain is very severe in most cases: every movement of the organ in articulation, mastication, or deglutition causes great suffering. The friction or compression by neighbouring teeth, the profuse salivation, all aggravate the patient's distress in this most agonising disease. The pain is not confined to the tongue, but runs through all the branches of the fifth nerve over the side and to the crown of the head, to the face and the ear. The lymphatic glands under the jaw usually become involved at an early period; but in epithelioma the disease may exist for a year or two without their becoming implicated. Cachexy at last supervenes, and the patient dies from the conjoined effects of exhaustion, irritation, starvation, and poisoning of the system. In some instances, when the posterior part of the tongue is very deeply affected, copious and fatal arterial hæmorrhage may occur and destroy life, from the ulceration extending into the lingual artery.

If cancer of the tongue be allowed to run its natural course uninfluenced by operation, nothing can exceed the misery of the patient's death, brought about as it is by pain, hæmorrhage, and starvation. When the patient dies by recurrence of the disease after removal, he has probably obtained some months of immunity from suffering; and, as the fatal termination usually takes place by secondary deposits and constitutional cachexia, with visceral complications, it is far easier than when directly due to the diseased state of the tongue.

**Diagnosis.**—The diagnosis of the various forms of disease of the tongue is important. The *foul and sloughing ulcer* may be distinguished from all others by the rapidity of its progress, its eroding action, and the absence of all induration at its base. *Syphilitic ulceration,* with an indurated base, commonly closely resembles cancer of the tongue; so closely, indeed, that it is only with great difficulty that the diagnosis can be effected. This, however, may generally be accomplished by observing that the syphilitic ulcer is elongated, irregular, does not rapidly extend, and is associated with mucous tubercles and other less dubious evidences of constitutional syphilis; while the cancerous ulcer is of a more circular shape, has hard and eroded edges, is more painful, and spreads with greater rapidity. The influence also of treatment will after a time throw light upon the nature of the disease; and the scrapings of the cancerous ulcer, when examined under the microscope, will always reveal its true character.

The diagnosis between the *syphilitic gumma* and the *cancerous tubercle* is most important; here the duration of the disease and the co-existence of constitutional syphilis must be taken into account. It is also of much moment to attend to the situation of the tumour; the syphilitic gumma being almost invariably met with deeply in the substance of the organ, whilst the cancerous growth is commonly seated at its edges or tip. It must, however, be remembered that a tongue which has long been the seat of those morbid changes in the way of thickening and ulceration of its epithelium and mucous membrane, which are the usual sequelæ of syphilis, may at length become affected by true epithelioma at one side, usually towards the middle third—that a syphiloma may thus by local irritation be at length converted into an epithelioma, the tongue being simultaneously affected by both diseases.

There are three conditions in cancer of the tongue that are of serious import, and that may, singly or in conjunction, lead to a fatal termination. 1. The pain not only wears out the patient by depriving him of rest and comfort in life, but, being greatly aggravated by mastication and deglutition, causes him to avoid these acts, and hence leads to a process of gradual starvation, either by his abstaining from food altogether, or taking a liquid and innutritious diet, because it is more easily swallowed than solid and more substantial meat. 2. The profuse salivation tends still further to exhaust the patient; and 3. The occurrence of hæmorrhage, when the disease has eroded so deeply as to open up one of the larger branches or trunk of the lingual artery, may, by repeated recurrence or by sudden gush, destroy life.

**Treatment.**—In the treatment of cancer of the tongue, medicines are utterly useless, except as palliatives of pain. No measures hold out any chance of recovery, or even of prolongation of life, except the complete removal of the diseased structure; and this it is by no means easy to accomplish, as the cancerous infiltration often extends much farther than at first appears, passing deeply between the muscular fasciculi and planes, into the root of the tongue. In these deep cancerous affections there is usually great enlargement of the glands under the jaw with infiltration of the floor of the mouth and neighbouring soft parts to such an extent as to render it impossible to excise or in any other way remove the whole of the disease.

There are two operations occasionally practised, having for their object to palliate the suffering or to retard the progress of the disease: viz., Division of the Gustatory Nerve, and Ligature of the Lingual Artery.

**Division of the Sensory Nerve of the Tongue.**—Section of the gustatory branch of the fifth nerve was first proposed and practised by Hilton, with the view of relieving the pain of the cancerous ulcer, retarding the progress of the disease, lessening the profuse salivation, and enabling the Surgeon to apply ligatures for the removal of the cancer to a part that has been deprived of all sensibility. This operation, which Moore repeated several times, and to which he specially drew the attention of the Profession, undoubtedly accomplishes the objects for which Hilton originally proposed and practised it; more especially so far as relief of pain and diminution of salivation are concerned. And it deserves to be considered as one of the most efficient modes of relief to the suffering produced by cancer of the tongue, in all cases in which an operation for the removal of the disease is not desirable or practicable.

The division of the gustatory nerve may be done in two ways; one originally employed by Hilton, the other adopted by Moore. Both operations consist in dividing the gustatory nerve, in that part of its course which extends from its emergence between the internal pterygoid muscle and the jaw to the point where it enters the tongue. Opposite to the second molar tooth, the nerve lies under the mucous membrane of the floor of the mouth. There it can be easily reached by the division of the mucous membrane covering it, when it will be found close behind the sublingual gland. It may be raised by a blunt hook, seen, and divided. It was in this situation that Hilton practised its section. The advantage of this choice of place is, that the nerve can be seen and its division thus rendered certain. The disadvantages are, that the guides to the spot are not quite certain; that the cut is apt to be obscured by hæmorrhage; and that, when the disease has extended to the floor of the mouth, the operation is inapplicable. Moore consequently recommended, and in five cases practised, the section of the nerve further back. The guide to it in this situation is the last molar tooth; and a line drawn from the middle of the crown of the tooth to the angle of the jaw will cross the nerve in the exact place where it should be cut. The nerve lies about half an inch from the tooth, between it and the anterior pillar of the fauces, parallel to but behind and below the bulging alveolar ridge, which can be felt in the lower jaw ascending towards the thin coronoid process. By entering the point of a knife, therefore, into the mucous membrane of the mouth, three-quarters of an inch behind and below the last molar tooth, and cutting down to the bone, the nerve must be divided. Moore advises that for this purpose a curved bistoury be used, as the projection of the alveolar ridge would protect the nerve from a straight blade. The good effect of the operation is instantaneous; pain ceases in the tongue, ear, face, and head, and the flow of saliva is greatly diminished: and the relief is continuous, for it does not appear that the nerve re-unites.

**Ligature of the Lingual Artery** may be required to restrain profuse hæmorrhage from an ulcerated cancer of the tongue. This operation has also been practised with the view of starving the morbid growth and thus retarding its development. That it does so for a short period is undoubtedly the case, but that it does so permanently is a fallacy. This operation has been recommended for these purposes by Demarquay, and has been performed in this country by Moore and C. Heath.

The lingual artery may be exposed and tied in the following manner.

The artery is reached with most certainty in the digastric triangle of the neck, where it lies beneath the hyo-glossus muscle. A curved incision from close to the symphysis menti, reaching down to the level of the hyoid bone, and prolonged upwards to near the angle of the jaw, will expose the lower border of the submaxillary gland. This being drawn up, the central tendon of the digastricus and posterior edge of the mylo-hyoideus will be brought into view, and the hypoglossal nerve with a vein will be seen lying horizontally upon the hyo-glossus muscle. These structures being drawn up out of the way, the fibres of the hyo-glossus must be divided horizontally about a quarter of an inch above the hyoid bone, when the lingual artery will at once come into view (Fig. 623).

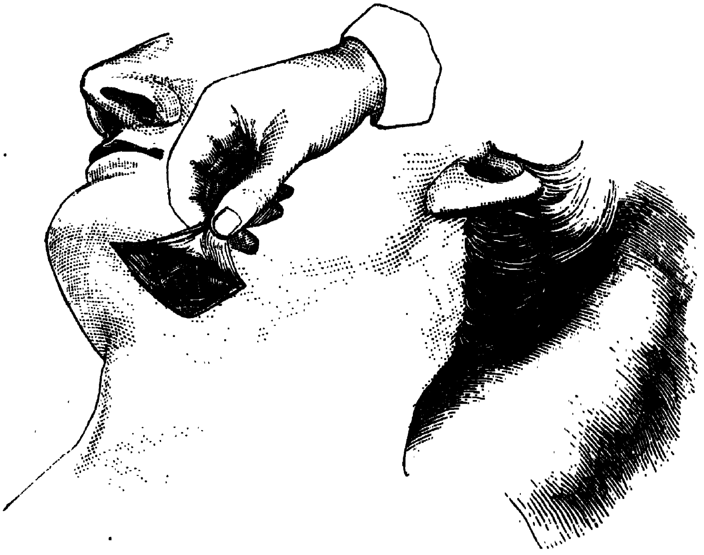

Fig. 623.—Ligature of Lingual Artery.

Operations on the Tongue.—The operations that are practised on the tongue when it is affected by cancer consist in the removal of a portion of the organ only, or its complete extirpation from the hyoid bone, according to the situation of the disease and the extent to which the tongue is implicated.

Unless the disease can be very fully and freely extirpated, it is better not to attempt any operation ; for in no organ is there a greater tendency to recurrence of cancer than in the tongue. No operation should be undertaken when the disease extends to the floor of the mouth, implicates the arches of the palate, or has largely infiltrated the submaxillary glands.

Three methods of operation may be employed when a portion only of the tongue has to be removed—viz., by the ligature, the écraseur, or the knife. When the extirpation of the whole organ is decided upon, the ligature is not applicable, and recourse must be had to the knife or the écraseur.

For the purposes of operation the tongue may be divided into three regions ; viz., the anterior third, the central lateral portion, and the posterior part.

When the tip or anterior third of the organ is cancerous, the ligature or the knife may be equally used. The écraseur, though preferable to either, and applicable, is not needed.

When the more central and lateral part is involved in disease, and requires removal, the knife, the ligature, and écraseur, are all available.

When the posterior part is involved, so that the whole organ requires removal, the Surgeon should choose between the knife and the écraseur.

In all operations upon the tongue, three precautions must be taken ; 1, to prevent the patient from biting it ; 2, to expose it thoroughly ; and, 3, to keep it under control. The first object is attained by placing a screw-gag between the teeth on the side opposite to the seat of operation; the other two by drawing the cheek aside by means of an angular spatula, and by passing a strong double whipcord ligature through the tongue about an inch and a half from its tip, and somewhat towards the side to be excised (Fig. 624). By this ligature an assistant draws the organ out of the mouth. The light should be good for these operations, and the Surgeon should have trustworthy assistants.

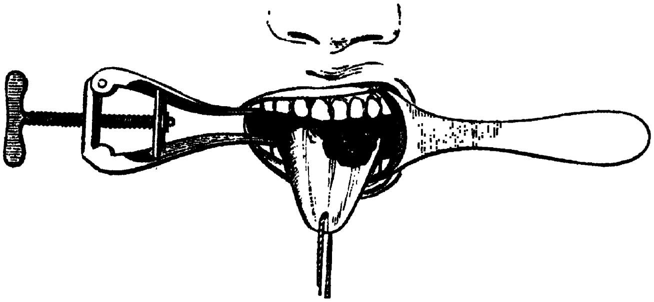

Fig. 624.—Application of Screw-Gag, Cheek-Retractor, and Whipcord, in Operation on the Tongue.

**Excision** may readily and safely be done when the free anterior portion only of the tongue is diseased, or when it is only superficially affected at its side or back part. In using the knife in these situations, the diseased part of the tongue should be seized by a vulsellum or broad-bladed forceps, and then freely and widely excised by means of a scalpel curved on the flat. The hæmorrhage is free, often profuse. It will usually cease very rapidly, by keeping the tongue well drawn forwards and ligaturing the artery that furnishes most blood—or the opposite sides of the cut may be drawn together with a whipcord ligature, and the bleeding surface compressed. Should the oozing continue rather abundantly, ice may be freely used.

**Strangulation** of the diseased mass by means of the **Ligature** was formerly much more employed than at the present day, and is indeed now seldom adopted, on account of the pain that attends and the fetor that follows its use. If, however, the Surgeon be single-handed or unprovided with trustworthy assistants, or if hæmorrhage be much to be avoided, this means may be employed.

For the purposes of this operation strong thick saddler's whipcord is the best, as it does not readily cut through the soft and brittle tissue of the organ, which will be the case if the small compressed cord usually sold by the instrument makers be used. There is little danger from hæmorrhage in or after this operation; and the pain and subsequent discomfort are usually much less than might be expected. The pain may be prevented by section of the gustatory nerve prior to the application of the ligature (*see* page 519).

The ligature is passed by means of an ordinary nævus-needle, or, what is often more convenient, a corkscrew needle curved on the side as well as to the point (Fig. 625). In many cases, the plan described for tying flat nævi will be found the most convenient mode of passing the whipcord round the cancer of the tongue (Fig. 626). In whatever way the ligatures are applied, care should be taken to pass them through the healthy tissue of the organ wide of the disease, and they should then be tied very tightly, so as to strangle the mass effectually. This may then be cut away by scissors, so as to diminish the quantity of slough that would otherwise be left in the mouth. Swelling of the tongue, followed by rather profuse salivation and fetor of the breath, attends this operation; but the mass, if properly constricted, will slough away in a few days, leaving a large gap that readily fills by granulation. When the disease extends so far back that it cannot readily be reached from the mouth, Cloquet, Arnott, and others, have successfully strangled it by making an incision in the hyoid region, between the genio-hyoid muscles, carrying the ligatures by means of long needles through the base of the tongue, and then drawing them tight through the aperture in the neck, so as to constrict the diseased mass.

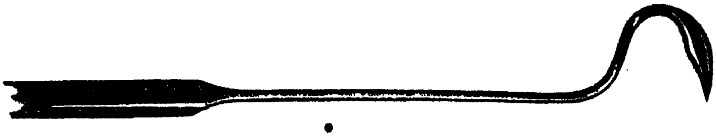

Fig. 625.—Corkscrew-Needle.

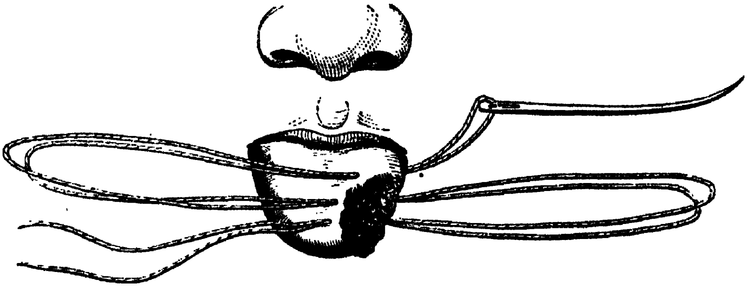

Fig. 626.—Application of Ligature to Cancer of Anterior Part of Tongue.

**Excision of the Whole or of a Large Portion of the Tongue.**—This bold operation may be performed in three ways:—1. From the inside of the mouth without any external incisions; 2. By the submental method through the mylo-hyoid space; 3. By the division of the lower lip and jaw, and the application of the écraseur.

The excision of the whole tongue *from the interior of the mouth,* without any external incision, was not and could not be safely practised before the introduction of the écraseur into surgical practice; and it is to Chassaignac that we are indebted for this advance in operative surgery. There are many methods by which this operation may be performed, the difference in the minor details being dependent on the extent and situation of the cancer, and the amount of tongue that consequently requires extirpation. The following plan is the one that is most usually adopted, and that will be found effectual and safe in the vast majority of cases.

The gag having been applied, the end of the tongue should be seized with hooked forceps and well drawn forwards and upwards. The Surgeon then cuts across the frænum by means of strong curved scissors, and divides successively the insertions of the genio-hyoid and genio-hyo-glossal muscles into the lower jaw, cutting freely backwards so as to liberate the base of the tongue. He now snips across the reflexion of the mucous membrane of the floor of the mouth from the lower jaw, and then, laying aside the scissors, separates widely with his fingers the base of the tongue from these parts. As he does this the assistant, who has charge of the forceps, draws the tongue well forwards, and it comes bodily out between the lips. If the anterior pillar of the fauces offer any obstacle it may be snipped across, and the wire of the écraseur may then be applied well round the back of the organ, the shaft being pressed up under the base of the tongue. If the wire have a tendency to slip forwards, a large double hook should be passed in front of it into the base of the tongue, so as steady it and prevent its slipping. By now working it gradually, the whole organ can be removed.

Nunneley, of Leeds, has devised an ingenious mode of applying the écraseur so as to remove portions of the tongue, or, indeed, the whole organ, as far back as the hyoid bone. This operation consists in passing the chain of the écraseur through the centre of the mylohyoid space by means of a sickle-shaped needle, about 4½ inches long and as broad as a bistoury blade. By this needle the chain is brought into the mouth close to the frænum. Two or three curved and strong hare-lip pins are now passed deeply into the tongue, obliquely, behind the seat of the disease, their points being made to project forwards below the organ, so as to prevent the chain from slipping. The loop is now gradually tightened, and the tongue is cut or shaved off obliquely from behind forwards.

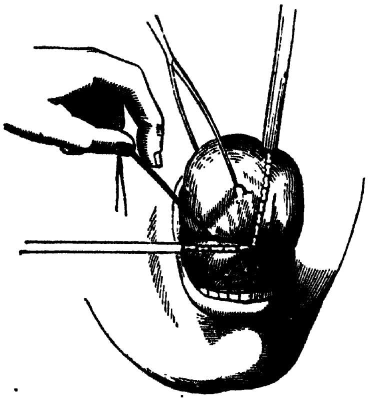

Fig. 627.—Two Écraseurs applied to Cancer of Tongue.

Two *écraseurs* have been successfully used by Chassaignac in removing portions of the tongue. When the disease only occupies one side, and it is not thought necessary to cut away the whole breadth of the organ, two instruments are required, which, as Chassaignac represents (Fig. 627), must be passed through the substance of the tongue in opposite directions, so as to isolate and detach the diseased portion.

In removing large portions of the tongue by means of the écraseur (Fig. 628), the instrument should be worked very slowly, in order that time may be given for the vessels to contract; but, even with this precaution, hæmorrhage may occur from the larger arteries to such an extent as to require the application of the ligature. Instead of the ordinary écraseur, Middledorpf's galvanic écraseur may most advantageously be used for the removal of portions or even of the whole of the tongue. It is applied in exactly the same way as the ordinary écraseur, and has these great advantages that by cauterising the divided surfaces all hæmorrhage is arrested, aud the action of the wire extends beyond the line of section. (*See* page 527.)

When the floor of the mouth is implicated in the morbid action, nothing should be attempted; as it is impossible to extirpate the whole of the disease in this situation, and partial removal of it will only be followed by rapid recurrence and increased activity of development. Slight enlargement of the glands under the jaw should not be any bar to the operation, provided the disease be limited, and the constitution good. If much enlarged, the glands may be excised at the same time with the disease of the tongue ; or if they be not of very considerable size, they may be left, when they will perhaps subside without the necessity of operation, as their enlargement may probably be dependent upon simple irritation ; should they continue indurated, they may readily be removed at a subsequent period.

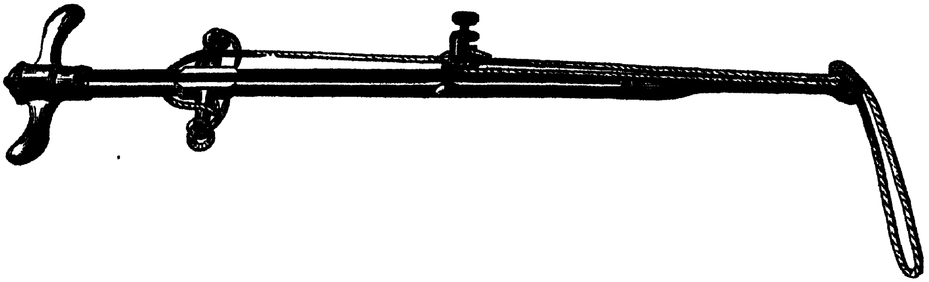
Fig. 628.—Wire Écraseur for Removal of Tongue.

**Submental Operation for Excision of Tongue.**—Regnoli of Pisa published, in 1838, a description of a method by which the whole tongue could be successfully removed. The plan that he proposed was as follows. An incision of a semilunar shape was made along the line of the lower jaw, beginning near one angle and terminating close to the other. A perpendicular incision was carried from the centre of this line immediately under the chin to the hyoid line (Fig. 629). In making this semilunar incision, care must be taken not to wound the facial artery on either side. The trunk of the vessel should be protected by the finger of an assistant as it curves round the lower jaw, and the incision should be confined within the space between the two facials. The triangular flaps of the skin formed in the manner indicated are dissected back, and the

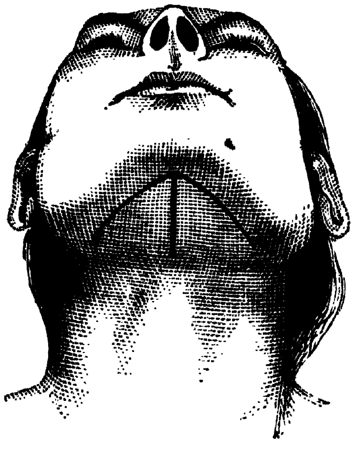
Fig. 629.—Lines of Incision in Regnoli's Operation.

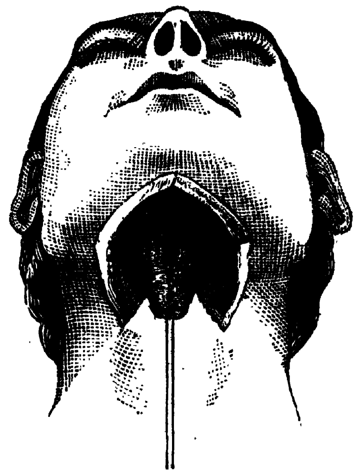
Fig. 630.—Tongue drawn out between Jaw and Hyoid Bone.

muscles and mylo-hyoid space are now exposed. These must be successively divided; the anterior bellies of the digastrics are cut across, the mylo-hyoid muscle divided transversely at its anterior part; and the attachments of the genio-hyoid and genio-hyo-glossi are then to be detached from the lower jaw by a few touches of the scalpel, and by separating with the fingers the mucous membrane of the floor of the mouth. An aperture is then made into this by pushing the scalpel through it, and its reflexion from the inside of the lower jaw is divided as far back as the outer angles of the external incision. The submaxillary glands are pushed aside, and the tip of the tongue being seized with a strong hook or vulsellum-forceps, the organ is drawn out to its full extent on to the anterior part of the neck, between the jaw and the hyoid bone, when the whole of it may be removed close to its attachments to the latter bone by means of the knife or the écraseur (Fig. 630). The latter instrument is to be preferred, as its use is attended by less hæmorrhage than follows that of the knife. It will occasionally be found that the anterior pillar of the fauces is somewhat in the way of the application of the instrument. Should this be inconveniently so, it may be snipped across before the wire of the écraseur is applied. By means of this operation, which I have several times performed, the whole of the tongue may be shaved off clean from the base of the epiglottis and hyoid bone. After the removal of the tongue the hæmorrhage will usually be found to be trifling; but should one or other of the lingual arteries bleed, it may readily be seized and ligated. The line of incision in the skin must then be stitched up and supported by strips of plaster.

*The Buccal Operation.*—Furneaux Jordan has introduced an operation which consists in dividing the cheek on the affected side backwards as far as the ramus of the jaw, care being taken to go below the parotid duct. The tongue is then seized in the usual way, and cut off by two écraseurs worked simultaneously, the chain of one dividing the organ transversely close to the pillars of the fauces, that of the other severing the tissues along the floor of the mouth. I have performed this operation in one case of unilateral cancer of the tongue, and found that the organ could readily be reached, commanded, and a portion removed through the gap in the cheek. After the operation is concluded, this is closed by hare-lip pins.

**Excision of Tongue after Division of the Lower Jaw.**—Sédillot of Strasburg described, in 1855, a method of removing the whole of the tongue, which he stated that he had practised for some years with success. The operation consists in making a vertical section through the lower lip, sawing through the inferior maxilla at its symphysis, separating the bone on each side, drawing the tongue forward and removing it. In performing this operation, its inventor recommends that the section of the lower lip should be made carefully through the median line, and carried across the chin as far down as the hyoid bone. The lower jaw is then sawn through at its symphysis. In order to fix the bone more carefully after the operation, he recommends that, instead of making one vertical incision, two oblique cuts should be practised with the saw in this shape >, so as to form a triangle, the point of which corresponds to the middle of the body of the bone, so that the two opposite sides may be locked together after the removal of the tongue. After having divided the lower jaw, the muscles connecting it to the tongue should be cut across; the floor of the mouth slightly detached from the bone, the two sides of which are drawn asunder; and the tongue then removed from the hyoid bone by a stroke of the knife. The lingual arteries bleed freely, and must be at once secured. Fiddes of Jamaica recommends that the artery be divided and tied, first on one side and then on the other, so as to avoid all danger of hæmorrhage. The opposite sides of the jaw-bone are then brought together, and held in position by wire twisted round the teeth, or passed through a hole drilled on each side, before the division of the bone. If Sédillot's angular cut be adopted, the bone may be kept *in situ* much more easily than if the vertical incision to which he first of all had recourse, and which is commonly adopted in this country, be practised. The incision in the lower lip must be united in the usual way by hare-lip pins or sutures. This operation was first done in this country by Syme and Nunneley, and has of late years been very extensively practised by many Surgeons. By it the whole tongue can be freely exposed and cut out from its deepest attachments.

As soon as the tongue is separated, the stump should be drawn forwards and any bleeding point tied. Ice should be freely used for some days. Should secondary hæmorrhage occur, it will be found that the actual cautery or the perchloride of iron, the free use of ice, or a spray douche of ice-cold water, will suffice to arrest it. A tendency to dyspnœa is sometimes manifested after the operation, owing to the hyoid bone falling backwards. This is remedied by opening the mouth and drawing the stump forward. The patient will not be able to swallow for some days,—the food, liquid as well as semi-solid, accumulating in the cavity left by the removal of the tongue. He must therefore be fed by enemata, and through an India-rubber tube passed down the œsophagus. There is often trouble from profuse salivation for two or three weeks, owing to the patient being unable to swallow the viscid saliva secreted by the wounded and irritated glands. This is best controlled by alum and pyrethrum gargles, and by brushing over the inside of the mouth with a solution of nitrate of silver.

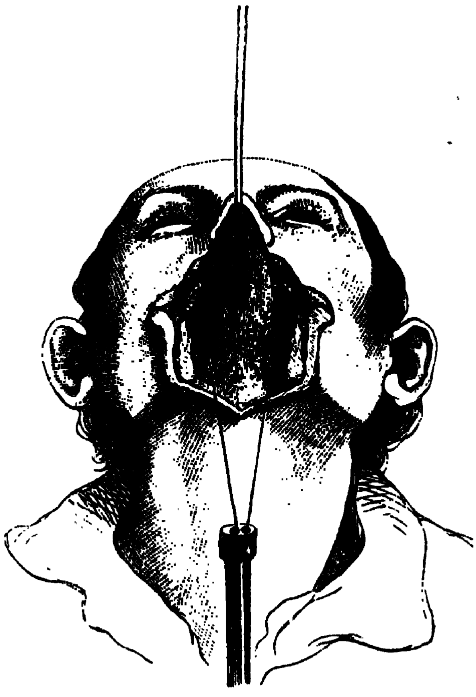

Fig. 631.—Removal of Tongue by Division of Lower Jaw and Écraseur.

**Removal of the Tongue by the Galvanic Ecraseur.**—Since the introduction of the galvanic écraseur, that useful and ingenious instrument is now generally used by Surgeons for the removal of the tongue after its exposure by the division of the lower jaw. In this way the loss of blood may be entirely avoided, the whole tongue being removed without the escape of a single drop.

The avoidance of hæmorrhage in the removal of the tongue is a great desideratum, as it is always troublesome and sometimes difficult to secure the bleeding vessels. If the knife be used for the removal of the tongue, the lingual arteries necessarily require ligature; and hence, if the organ have to be taken off near to its root, it is better to do this by one of the operations which open up the cavity of the mouth, such as division of the lower jaw, as in that way the requisite space can be obtained to draw the root of the divided tongue well forward and to apply the ligatures.

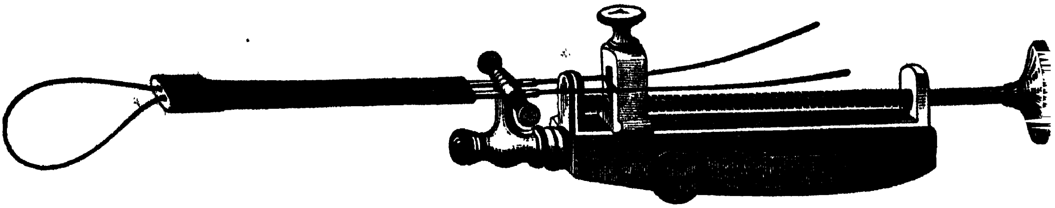

Fig. 632.—Galvanic Écraseur.

In using the ordinary écraseur, much depends on the thickness of the wire or chain. Should this be too thin, it will cut at once through so fragile an organ as the tongue, and profuse bleeding will ensue. But if the écraseur have a moderately thick wire and be worked very slowly, the tongue may be removed with little or even no loss of blood. In order to secure this desirable result, the galvanic écraseur should be used in preference to the simple one. By working this slowly, using a platinum wire, and not employing too high a temperature—a good red heat is quite sufficient—the whole organ may readily be removed without the loss of a drop of blood. This I have done in several cases, in which the whole tongue required removal, from the inside of the mouth, without any cutting through cheek, jaw, or submental tissues. The operation is thus greatly simplified, for all that is required is to divide, by means of a pair of scissors, the insertion of the lingual muscles into the lower jaw, to tear up the mucous membrane on each side by the finger, and perhaps snip the anterior pillar of the fauces, when the tongue can be drawn fairly out and its section completed.

The following is a summary of the steps for the removal of the whole tongue from the hyoid bone by means of the galvanic écraseur.

1. Chloroform, not ether, must be administered, as ether-vapour will ignite when the écraseur is used.

2. An incision is made exactly in the median line through the lower lip, carried over the chin, and as far down as the hyoid bone.

3. The mucous reflexion, from the lower lip to the gum on each side, is dissected back.

4. The lower jaw is drilled on both sides, half an inch beyond the median line, midway between the alveolus and symphysis.

5. The lower jaw is sawn through exactly in the median line.

6. A whipcord noose is passed through the forepart of the tongue.

7. The two fragments are separated; the genio-hyoid muscles, &c., are cut with scissors, and by means of the fingers and scissors all the soft structures on each side of the tongue are separated.

8. The tongue is then drawn forwards, and a stout nævus-needle is passed up through it behind the disease.

9. The noose of the galvanic écraseur is passed over the whipcord stay and behind the needle, and tightened.

10. The electric current is turned on, and the tongue slowly cut through.

11. During this process, the pharynx must be mopped out with sponges.

12. After the removal of the tongue the stump must be drawn forward, and examined for any bleeding point.

13. The two sides of the lower jaw are then brought together by wire sutures passed through the drill-holes, and the cut through the lip by harelip pins.

14. A drainage hole should be left behind the symphysis of the jaw, at the lower end of the incision.

In comparing the relative merits of the simple and galvanic écraseur for the removal of portions of the tongue, it may be said that both instruments are equally efficacious in the performance of the operation itself; that the division of the organ by the simple écraseur is more liable to be followed by hæmorrhage at the time of the operation, which may always be readily controlled by ligature; that the action of the galvanic écraseur is more likely to be followed by secondary hæmorrhage about the fifth or sixth day, at the period, in fact, of the detachment of the sloughs produced by its cauterising action; but that by the very production of these sloughs the cauterising influence is extended into the stump to some depth beyond the line of incision, and thus tends to destroy morbid deposits or scattered cells, beyond the line of the actual section. In all respects, then, except so far as the liability to secondary hæmorrhage is concerned, the galvanic écraseur, in my experience, which, in my own practice and that of others, has been large in these cases, has the advantage over the simple wire one.

Hæmorrhage, at the time of the operation, may be arrested by drawing the tongue-stump forwards by means of hooked forceps, and tying the cut lingual artery with whipcord. As the tissues are brittle, this should include some surrounding structure. The ligature ends are all cut short. In one case, a coagulum formed in the pharynx before the vessel could be secured; and I had to perform laryngotomy. The patient made a good recovery, dying two years after the operation, from recurrence of the disease in the chest and one of the toes.

Secondary hæmorrhage may be restrained by means of ice, the application of perchloride of iron, and pressure on the bleeding part. But if not fatal at the time, it is apt to be so by its recurrence, and by inducing exhaustion.

**Comparison of Methods of Operation.**—In instituting a comparison between the three different methods of dealing with tumours of the tongue by ligature, the knife, and the écraseur, it should be understood that the same plan of treatment is not equally or indiscriminately applicable to all cases, but that one or other should be adopted according to the size, situation, and extent of the cancerous mass. If this be small and situated at the tip of the organ, this portion of the organ may be easily, quickly, and safely excised. If the disease be situated towards the side, so as to require the removal of perhaps one half of the anterior third of the organ, it may be cut out; but I think that it will be found safer and more convenient to ligature it. If it occupy the whole breadth of the anterior third, or even half of the tongue, I consider that removal by the galvanic écraseur is the simplest and safest procedure. If the posterior part be superficially affected, the disease may be cut out. But if the organ be so deeply affected that the whole of it requires extirpation, the galvanic écraseur will be found to be easy of application, safe and efficient in execution; and the Surgeon must have recourse to Sédillot's operation of the division of the lower lip and jaw in the central line, and the complete extirpation of the cancerous mass.

**Effect of the Removal of the Tongue on Speech.**—Although distinctness of articulation is necessarily affected for a time by these operations on the tongue, yet it is usually completely restored when only the anterior third or half is removed; the tissue of the organ recovering its normal mobility with remarkable facility, and indeed appearing to possess a very considerable reparative power, so as almost to seem to be capable of reproduction to some extent. Even after removal of the whole of the tongue, the power of deglutition is preserved, and that of articulation, although at first somewhat imperfect, eventually returns, so that the patient is able to speak so distinctly that strangers would not be aware of the loss he had sustained. Amongst the tortures to which Christian martyrs were subjected in the early ages, and the punishments which have been inflicted on heretics, "cutting out the tongue" was one of the most barbarous. Martyrologists in describing this horrible mutilation have remarked with wonder, that, although it was practised with the view of depriving the sufferers of the power of speech, yet it often failed in its effect, and those who had been subjected to it were enabled to speak afterwards as plainly as before. This they have attributed to direct miraculous intervention. But, as modern Surgery has shown that the power of speech returns equally, whether a cancerous tongue have been extirpated by the knife of the Surgeon, or a heretical tongue by that of the executioner, we must rather look upon the return of speech as a physiological act, than as a miracle specially wrought for the benefit of those mutilated in and for the propagation of the true faith.

ENCYSTED, FATTY, and ERECTILE TUMOURS are met with not only in the tongue, but underneath it in the floor of the mouth. They require extirpation by the ligature, or enucleation by the scalpel, according to their situation and size; and for these irregular operations no special directions can be given. In removing such tumours as these, when situated under or by the side of the tongue, the knife must necessarily be used with much caution. It must, however, be borne in mind that, if these growths cannot be reached from the inside of the mouth, they may be got at by incision through the mylo-hyoid region, where there is but a slight thickness of soft parts between the surface and the floor of the mouth.

**Ranula,** the most remarkable and common of the buccal tumours, may occur under two forms.

1. A globular swelling, semi-transparent, evidently containing fluid, and often attaining the size of a walnut or a pigeon's egg, may be situated under the tongue, pushing this organ upwards and backwards, and consequently interfering with deglutition and speech (Fig. 633). The walls of the cyst are usually thin, with small vessels ramifying on them; its contents are glairy and very unlike saliva. This form of ranula is usually said to be a dilatation of Wharton's duct; but there is no proof of the disease being of this nature, nor is it very easy to understand how so small a duct can be dilated to so large a size as is occasionally attained by these tumours, which seem, in some cases at

least, rather to consist of independent cystic formations, such as commonly occur in connection with other secreting glands, and in other parts of the mouth. And this view of the case is strengthened by the fact that these globular cystic tumours containing glairy fluid may occur in the substance of the tongue itself, far away from any salivary duct.

Morrant Baker, who has investigated the connection between ranula and the Whartonian duct, finds that, in cases of ranula, Wharton's duct is quite free, without any alteration in size, and that saliva may be seen issuing from it. A probe passed into the duct is separated from the ranula by a thin membranous wall, showing clearly that the duct and the ranula do not communicate.

I have, however, lately seen a case in which a ranula resulted from a wound of the floor of the mouth, in the situation of the Whartonian duct. The wound was caused by the accidental slipping of a pair of tooth-forceps during extraction of the first molar tooth. As the wound healed a ranula formed, the contents of which were thick and ropy, like the natural secretion of the submaxillary gland. It ultimately reached the size of a plover's egg. That this tumour was formed by an accumulation of the secretion of the submaxillary gland, there can be no doubt; but it is quite possible that the collection formed in the submucous tissue, and that it was not enclosed in an actual dilatation of the Whartonian duct.

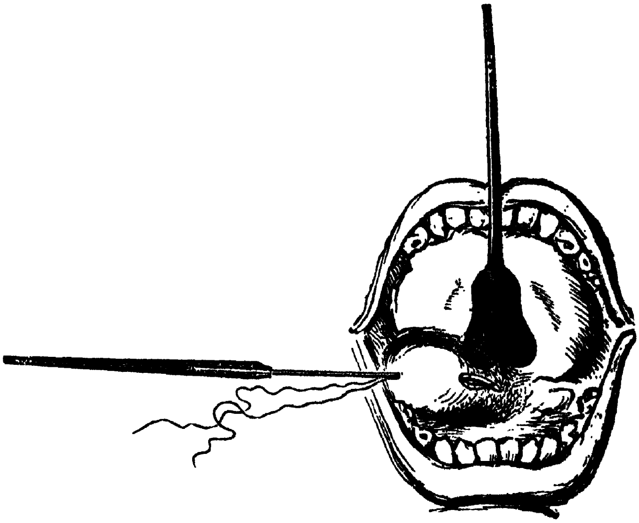

Fig. 633.—Ranula: Introduction of Seton.

The *Treatment* of this form of ranula consists either in passing a seton through its walls, so that contraction may take place on this (Fig. 633); or else in the excision of a large portion of the anterior wall of the cyst, the remainder contracting, until it at last becomes obliterated.

2. Besides the ordinary form of ranula, an encysted tumour, partaking of this character, is occasionally met with, lying above the mylo-hyoid muscle, between it and the buccal mucous membrane. It projects more distinctly into the neck than into the mouth, and thus forms a large tumour under the angle and body of the jaw, soft or elastic, and semi-fluctuating, occupying, perhaps, all the space between the lower jaw and the hyoid bone on one side. It attains the size of an orange. In a case of this kind under my care, the contents of the tumour, which closely resembled cream-cheese in character, were atheromatous, being composed of epithelial scales and fatty matter.

*Treatment.*—These tumours are best treated by making a free opening into them from the mouth, squeezing or spooning out their contents, stuffing the cavity with lint, and allowing it to granulate and contract. If an attempt be made to extirpate them from without, the profuse hæmorrhage, the firmness with which the cyst-wall is incorporated with surrounding parts, and the danger attendant on the free use of the knife in the neighbourhood of such important parts as lie between the mylo-hyoid muscle and the tongue, will render such an operation not only unsatisfactory, but hazardous.

SALIVARY CALCULI are occasionally met with in connection with the sublingual, submaxillary, and parotid glands. They are most common in the sublingual gland, and will then be found to be situated in the Whartonian duct. From this situation I have two or three times removed them. Gross mentions a case of calculus in the duct of the submaxillary gland. Wherever occurring, they obstruct the duct and produce retention of saliva in it. Hence, when the salivary glands become actively secreting, as at mealtimes, the calculus, by preventing the escape of the salivary fluid, causes distension of the gland, with pain and tenderness, so as to render mastication difficult.

The *Treatment* is simple. It consists in dividing the mucous membrane over the calculus and then extracting it with forceps. The largest which I have removed was of the size of a small damson-stone; it was loose in Wharton's duct.

## DISEASES OF THE UVULA AND TONSILS.

ELONGATION OF THE UVULA.—The uvula occasionally becoming elongated and hanging down into the pharynx, so as to touch the epiglottis and sensitive mucous membrane in its neighbourhood, gives rise to a great irritation of the fauces, and to a tickling or spasmodic cough, which can only be cured by removing the pendulous body. This little operation may be readily done by seizing the end of the uvula with a pair of polypus-forceps, and snipping it across near the root with a long pair of scissors. It is better not to remove the whole of the uvula. If this be done, throat-irritation is apt to continue. I have been most satisfied with the result of those cases, in which a stump from a quarter to the third of an inch in length has been left. For some years I have been in the habit of using a pair of "vulsellum-scissors" (Fig. 634), by which the uvula is cut off at the same moment that it is seized, thus rendering the operation easier and less irritating to the patient. A very ingenious American instrument, consisting of a pair of forceps and scissors combined, may be employed with the same view; by closing the handles of this instrument the uvula is first seized, and is then immediately cut across (Fig. 635).

TONSILLITIS OR QUINSY.—The tonsils are not unfrequently the seat of disease, becoming inflamed or permanently enlarged. When inflamed, they become swollen and red, with much pain in the side of the neck and ear, increased by any attempt at swallowing; there is usually rather a profuse secretion of saliva, and a good deal of swelling under the angles of the jaws; the tongue is much coated with thick pasty mucus, and the voice is thick and nasal. The disease comes on suddenly, often accompanied by high fever, chills, and occasionally even delirium. The thermometer frequently rises to 105°, or even higher. In some cases, a trace of albumen may be found in the urine. Tonsillitis is often caused by exposure to impure air, such as results from the escape of sewer-gas into a house, and it is not uncommon amongst the residents in hospitals. It may be mistaken for diphtheria, scarlet fever, or erysipelas of the fauces. From diphtheria it is distinguished by the absence of exudation. The mucous secretion from the tonsil may somewhat resemble diphtheritic exudation, but it is readily distinguished by its want of adherence, as it is easily removed with a camel's-hair pencil. From scarlet fever, tonsillitis is distinguished by the absence of the red tongue, and by the redness of the throat being purple in tint, and limited to the tonsils and their immediate neighbourhood, and later on by the absence of rash. From erysipelas of the fauces it is more difficult to distinguish, but it will usually be found that the redness is darker in tint and less diffused than in erysipelas, and there is less œdematous swelling, and no tendency to the supervention of dyspnœa from œdema glottidis. There is also less glandular enlargement at the angle of the jaw.

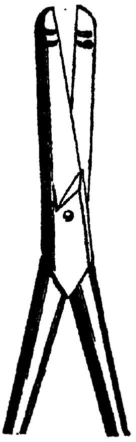
Fig. 634.—Vulsellum-Scissors.

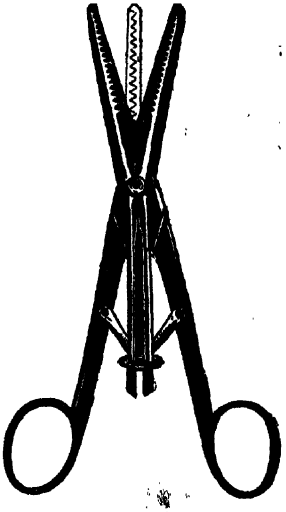
Fig. 635.—Forceps-Scissors.

The *Treatment* should always be commenced by a good purge; a calomel and colocynth pill will be found most efficacious if it can be taken. This is followed by the application of leeches under the jaw, of fomentations, the inhalation of the steam of hot water, and low diet, which need scarcely be enforced, on account of the difficulty and pain in swallowing. If the mouth can be opened, much relief may be given by scarifying the tonsils with a probe-pointed bistoury; and, if abscess form, it should be opened early with a gum-lancet. The inhalation of the steam from a pint of boiling water, to which has been added a teaspoonful of creasote or carbolic acid, will often give much comfort by allaying the fœtor of the breath.

Hypertrophy of the Tonsils.—The tonsils may undergo various structural changes. They may become hardened and enlarged as a consequence of repeated attacks of inflammation, or chronically and indolently hypertrophied by an expansion or outgrowth of their follicular structure independently of any inflammatory attack; or this chronic hypertrophied state may be greatly increased by plastic inflammatory deposit.

When the tonsils are chronically enlarged, one usually suffers to a somewhat greater extent than the other. The condition is at once obvious on opening the mouth and depressing the tongue so as to expose the fauces fairly, and cannot be mistaken for any other morbid state.

There are two distinct forms of chronic enlargement of the tonsils. In the one case, these organs become hypertrophied in otherwise healthy children in consequence of repeated attacks of inflammation, more especially consequent on croup, diphtheria, scarlatina, or measles. In these cases the tonsils are red, congested, and very liable, under the influence of slight occasioning causes, to violent attacks of acute inflammation with ulceration or abscess.

The **Chronic Indolent Hypertrophy** presents different characters; in it the tonsil is large, rather pale, hard, smooth, and semi-elastic. This disease is one which occurs in children and young persons who have a general tendency to struma of the mucous membranes and their appendages. Most commonly it develops without any assignable or external cause, usually commencing at five or six years of age, and gradually increasing up to puberty, a period when the functional activity of these glands is greatest, and when they are most exposed to irritation from zymotic diseases, especially scarlatina and measles. When once the tonsils have enlarged, they become a source of great inconvenience and of even serious derangement of health. The child is liable to attacks of inflammation of the throat, the tonsils then becoming congested, greatly swollen, and readily running into ulceration or suppuration. In consequence of these repeated attacks of inflammation, the enlargement of the tonsils increases, they become indurated, rugged-looking, and nodulated, projecting far forwards into the fauces, and sometimes even touching each other below the uvula. Respiration, articulation, and deglutition are now seriously interfered with. The mucous membranes of the nose and eyes become chronically congested, and there is an increased secretion, from the back of the throat and nose, of thick, tenacious, unhealthy, or fœtid material, the swallowing of which is deleterious. The child cannot sleep without snoring, and is apt to start up with a feeling of suffocation; the voice becomes thick and husky; the sense of hearing is blunted; and, partly from the incipient deafness, partly from the difficulty of breathing, causing the child to keep its mouth half open, the countenance assumes a peculiar vacant, semi-idiotic expression, which is very characteristic of the advanced stages of the disease. The most serious effect is the impediment to inspiration, which in the more chronic and severe forms of enlarged tonsils will go to such an extent as to prevent the full inflation of the lungs, and thus occasion a permanent flattening and contraction of the chest, imperfect aëration of the blood, and an interference with general nutrition.

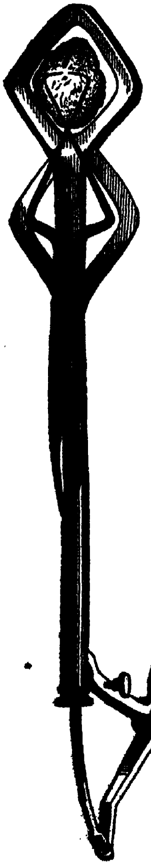

Fig. 636.—Tonsil-Guillotine applied.

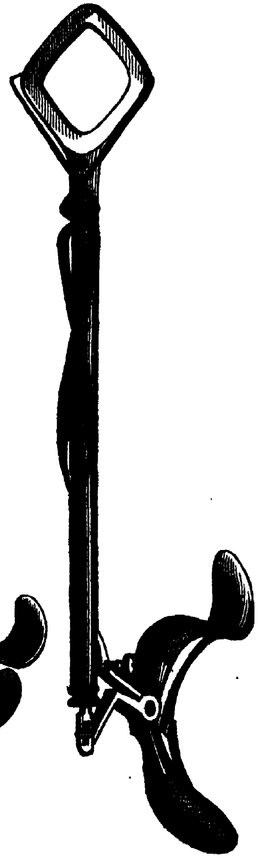

Fig. 637.—Tonsil Guillotine shut.

The *Treatment* of chronic enlargement of the tonsils will vary according to the age of the child, and the degree and kind of hypertrophy and induration of these organs. In the earlier and slighter forms of the disease, the enlargement of the tonsils may gradually subside as the child grows older and stronger; and it is well not to be in too great a hurry to excise the tonsils in young children, but rather to adopt a course of constitutional treatment with the view to the improvement of the general health, by means that are ordinarily had recourse to in the management of struma. The internal use of iron, and the local application of the tincture of iodine, of nitrate of silver, or of burnt alum, are occasionally serviceable. In the majority of instances, however, the disease will not be materially influenced by any therapeutic means that may be adopted: and as the enlargement, continuing or increasing, gives rise to difficulty in respiration, and thus interferes with the due arterialisation of the blood in the lungs, and impairs the child's speech, it becomes necessary to remove that portion of the growth which projects beyond the arches of the palate. This may best be done by the ordinary tonsil-guillotine. The ring of the instrument being passed over the tumour, the cutting blade is pushed forwards, and thus a slice of the projecting part of the growth is removed. In some cases difficulty is experienced in bringing the tonsil fairly into the ring of the instrument; this may be obviated by drawing it through with a vulsellum or double hook, and indeed, in some of the machines sold for the purpose a double hook is attached, which, being fixed into the tonsil, draws it forwards before it is sliced off (Figs. 636, 637). In performing this operation it is best for the Surgeon to stand behind the patient, more particularly in excising the right tonsil, as he can thus look better into the mouth and have more command over the head; or he may stand in front, and use the left hand for the right tonsil, and *vice versâ* (Fig. 638). Should a guillotine not be at hand, the tonsil may be removed by seizing it with a vulsellum, drawing it forwards, and then taking off a slice with a probe-pointed bistoury, the base of the blade of which should be wrapped round with a piece of plaster, to prevent its wounding the tongue. In excising the tonsil in this way, care must be taken to cut from below upwards and inwards towards the mesial line, and on no account to turn the edge of the knife outwards, lest the internal carotid artery be endangered. The hæmorrhage that follows this operation is usually very trifling; but it may be sufficiently abundant to endanger the patient's life. In such cases, ice and gallic acid will usually arrest the bleeding. In one case, I found a gargle of spirits of turpentine suspended in mucilage effectual after all other means had failed.

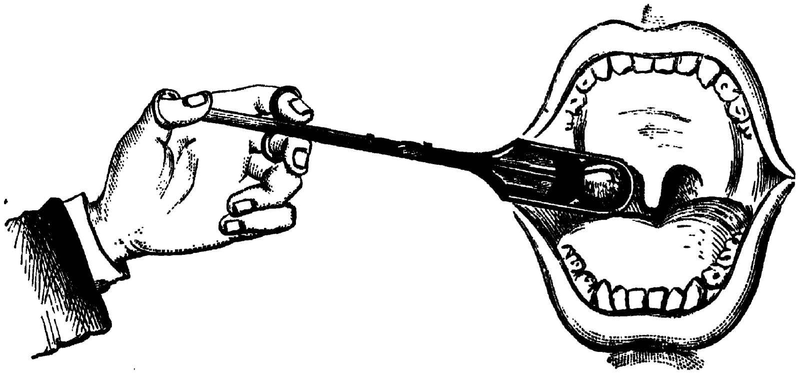

Fig. 638.—Removal of Right Tonsil with left hand

It has been stated by some that excision of the tonsil is liable to be followed by want of development of the testes.* This I have never observed. But it is possible that enlargement of the tonsils to such an extent as to impede respiration, and consequently to interfere with nutrition, may lessen the due development of the generative or any other organs of the body.

**Malignant Disease of the Tonsil** is not of common occurrence. I have, however, seen instances both of scirrhus and of epithelioma in this organ as a primary affection. In these cases the disease speedily extends to the pillars of the fauces, the pharynx, and onwards to the floor of the mouth, the glands under the angle become implicated, extensive infiltration of a brawny character takes place in and around them, the swallowing becomes extremely painful and difficult, respiration is impeded, the pharynx and palate become congested and loaded with viscid mucus, and the patient eventually dies in a distressing manner, partly from starvation, partly from constitutional contamination. Surgery only offers the means of relief in these sad cases, but can do nothing of a curative character. In a case of encephaloid of the tonsil which was under my care, I obtained some temporary advantage by removing portions of the soft projecting and very vascular tumour by means of the écraseur.

## DISEASES OF THE PHARYNX.

**Inflammation of the Pharynx** of a diffuse erysipelatous character, with low fever, not unfrequently occurs; it is best treated by the application of a strong solution of nitrate of silver, the use of emollient gargles, and the internal administration of ammonia, with bark, stimulants, and support. If it have a tendency to run into sloughing action, the internal administration of the mineral acids, with bark and stimulants, the nitrate of silver lotion, and chlorinated gargles, are useful. Sometimes abscess forms in the substance of the velum, and then requires to be opened with a narrow-bladed bistoury.

**Abscess** occasionally forms in the areolar tissue behind the pharynx, between the vertebral column and its posterior wall, which is consequently pushed forward so as to occlude the posterior nares, giving rise to a peculiar nasal intonation of voice, if the abscess be situated high; if low down, the consequences are more serious, as it may interfere with respiration by pressing upon the upper part of the larynx. This kind of abscess is often connected with disease of the bones at the base of the skull, or of the upper cervical vertebræ. In many cases, if left to itself, it would burst through the mucous membrane into the mouth; but in others it comes forwards under the sterno-mastoid muscles into the fore part of the neck. By exploring the pharynx with the finger, which may readily be done, tension and fluctuation through its posterior wall may easily be made out.

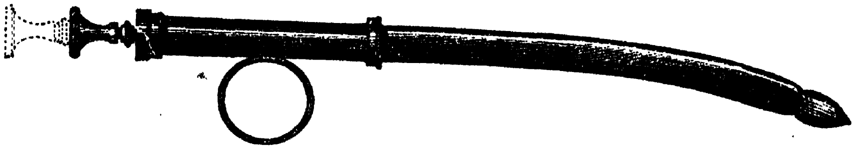

Fig. 639.—Pharyngotome.

In these cases the *Treatment* simply consists in letting out the matter by puncturing the tense membrane covering it. This may be done by means of a sharp pointed bistoury properly protected, the ordinary abscess-knife, or a pharyngotome (Fig. 639). The pus let out is usually offensive, even though the bones be not affected.

Tumours are occasionally met with in the postpharyngeal areolar tissue, giving rise to the same swelling, difficulty in respiration and deglutition, and lateral projection, as occur in abscess of this region. These growths are mostly *cancerous*, and speedily prove fatal. *Polypi* in the pharynx usually come down from the nasal cavities, but sometimes spring from the inside of this canal on one or other of its margins. They are usually, when truly pharyngeal, of a malignant character, and grow with great rapidity. The uses of the part are necessarily interfered with, and death may eventually result from obstruction to deglutition and respiration. *Epithelioma* of the pharynx has occasionally been met with (Fig. 640). This form of the disease, which is of rare occurrence, does not differ from similar growths elsewhere.

## STRICTURE OF THE ŒSOPHAGUS.

All diseases of the œsophagus have a tendency to constrict and eventually to occlude its passage, and hence are commonly described as **Strictures** of it. In some instances, the constriction of the œsophagus may be of a purely *nervous* or *spasmodic* character; but in the majority of instances it is the result either of fibrous or of cancerous degeneration of the walls of the canal, and is then termed *organic* stricture. The simple non-malignant or fibrous stricture in most instances eventually degenerates into epithelioma, and hence appears to be more rare than in reality it is, as it is seldom met with after death in its undegenerated form. Scirrhous and encephaloid growths may, though rarely, develop in and around the œsophagus.

The great feature of œsophageal stricture is difficulty of deglutition; but dysphagia may arise from many causes besides œsophageal stricture. Hence its diagnosis is in the highest degree important.

Conditions producing Dysphagia independently of Stricture.—There are at least eight different conditions met with in the neck and chest capable of giving rise to dysphagia by compressing the œsophagus, independently of any stricture of that canal.

1. **Tumours connected with the Pharynx.**—Putting out of consideration tumours of the tonsils, which would always be readily discovered, *polypus* of the pharynx may hang down and offer obstructions to the passage of food. In all polypoid growths connected with the pharynx (which are exceedingly rare) the nature, connections, &c., of the growth may be made out by drawing the tongue well forward, keeping it fixed with the tongue-spatula, and passing the finger well down behind the root of the organ; the pharynx can thus be explored, even below the root of the epiglottis, without much difficulty. *Abscess* may exist between the posterior wall of the pharynx and the spine, possibly arising from caries of the cervical vertebræ; or a *postpharyngeal tumour*, as, for instance, a sarcomatous growth, may be developed from the bodies of the vertebræ, and push the pharynx forwards. The eye is often

deceived in these cases, failing to detect the existence of an enlargement at the back of the pharynx; but the finger readily recognises it. In the case of abscess there is fluctuation, and the dysphagia will be removed by opening the abscess and letting out the contents; and the solid, or semi-solid and soft, or other feel of a tumour in this situation will lead to a very probable guess as to its nature.

2. **Morbid Conditions of the Larynx.**—Œdema about the back of the epiglottis, or chronic œdema, ulceration, and thickening of the mucous membrane there, or œdema about the rima glottidis, may give rise to a tendency for liquids to pass into the air-passages, and thus occasion a serious impediment in swallowing, the difficulty being attended with a feeling of spasm and suffocation. By passing the finger down behind the root of the tongue, the state of parts can often be felt; but the combination of dysphagia with a suffocative fit, and these probably associated with laryngeal cough, are the chief points to be attended to in the diagnosis.

3. **Tumours in the Neck outside the Œsophagus.**—Enlarged glands or a carotid aneurism, developing posteriorly, as has been known to occur with the internal carotid artery; or a tumour connected with the thyroid body, tightly bound down by the sterno-mastoid muscles and cervical fascia, may, by pressing on the œsophagus, give rise to dysphagia. In all cases where that symptom is complained of, the neck should be examined carefully for tumours, which will generally be very readily detected, especially where the difficulty has existed for some time, and the person has become much emaciated from deficient nourishment.

4. **Aneurism of the Innominate Artery.**—When this disease has risen into the root of the neck it is easily recognisable; but in certain cases it develops first in a direction backwards, and then one of the earlier symptoms is dysphagia. Indeed, the patient may suffer but little from any other symptom, and may apply to the Surgeon for relief from it alone, quite unconscious of the existence of any serious disease. The diagnosis will be effected by careful attention to the symptoms described at pp. 74—76, vol. II. In such a case, much danger might be incurred by at once putting an instrument into the œsophagus, under the impression that stricture existed; for the point of the bougie, or whatever instrument might be used, might perforate the sac of the aneurism, and so give rise to instant death.

5. **Aneurism of the Aorta,** whether of the fusiform or the sacculated variety, may give rise to difficulty of deglutition by pressure on the gullet. In this case, also, there is great danger of the aneurismal sac being pierced by an instrument passed down for the purpose of ascertaining the existence of stricture. The presence of the symptoms of intrathoracic aneurism, described at pp. 68—72, vol. II., will determine the diagnosis.

6. **Intrathoracic Tumours,** such as enlarged bronchial glands, cancerous and other tumours, may be developed from the thoracic spine into the posterior mediastinum, and so compress the œsophagus. In such cases the diagnosis is very difficult. It is difficult enough to determine the existence of a tumour, but still more so to distinguish it from an aneurism undergoing consolidation; but dulness on percussion, and dyspnœa with dysphagia, together with fixed pain in or to one side of the spine, with neuralgia down the arms or up the

side of the head, and a varicose condition of the superficial veins of the chest, are the signs on which we place our chief reliance in diagnosing the existence of a tumour. Indeed, in the diagnosis of aneurism of the aorta and of mediastinal tumour, I look upon the combination of dyspnœa with dysphagia, and fixed wearing pain between the shoulders, as of the greatest importance.

7. **Dislocation of the Sternal End of the Clavicle Backwards,** whether merely a simple dislocation, or produced in consequence of excessive curvature of the spine, may give rise to difficulty of deglutition. Of the latter kind there is at least one case on record, which is narrated by Sir Astley Cooper, in which the sternal end of the clavicle by its pressure so obstructed the passage of food, that the patient was brought into a condition of extreme danger. The Surgeon, under whose care the patient was, very skilfully and creditably sawed through and detached the sternal end of the clavicle, and thus relieved his patient from the imminent danger in which she was placed.

8. **Impaction of a Foreign Body in the Gullet.**—If a man swallow such a thing as a piece of mutton-bone, or the settings of artificial teeth, it generally lies across the gullet in such a manner as to be easily felt by the Surgeon on passing a probang ; but there are other cases in which a foreign body becomes so lodged in the canal as to escape detection and removal. Some years ago I was requested to see a patient who was said to have swallowed a piece of gutta-percha. He had, it appeared, in consequence of having lost several teeth, endeavoured to construct an artificial masticatory apparatus for himself, which had become loose, and he had accidentally swallowed it. A few days afterwards, finding that deglutition continued difficult, he consulted a very able Surgeon, who carefully examined him ; but, not detecting any foreign body, he considered that the piece of gutta-percha had passed into the stomach, and that the œsophagus had been scraped by it in its passage down. Inability to swallow solids came on. I saw him six months afterwards. The question then was, whether the foreign body was still impacted in the œsophagus, or whether the symptoms arose from damage inflicted on that tube. I examined the œsophagus most carefully, but failed, as other Surgeons had previously done, to discover the existence of any foreign body. I thought that the œsophagus had been injured in some way, and that probably epithelioma was developing itself, and would, sooner or later, prove fatal. One day, while at dinner, the patient suddenly vomited a large quantity of blood, and fell down dead. On examination after death, we found that the piece of gutta-percha had formed for itself a bed in the wall of the œsophagus, lying parallel with the inside of the tube, and that the ulceration of the mucous membrane caused by its presence had opened some œsophageal vessel—which, we could not ascertain (it was not, however, either the carotid artery or the jugular vein) ; thus giving rise to the copious and sudden hæmorrhage which had caused the patient's death. The surface of the gutta-percha which looked into the œsophagus, being constantly covered and smoothed over by mucus, and being protected, as it were, by a rim of swollen mucous membrane all around it, had allowed the probang to pass easily without its presence being detected.

These, so far as my experience goes, are the eight conditions which are likely to simulate stricture of the œsophagus; and such are the points to be attended to in the diagnosis of these affections from each other. With regard to their diagnosis from stricture, the process is rather a negative than an affirmative one, proving the absence of tumour, aneurism, &c. The conclusion that the difficulty of deglutition can arise from no other cause than stricture is arrived at by a process of exclusion: and the situation and extent of the stricture are ascertained by exploration with a gum-elastic catheter or bougie.

FORMS OF STRICTURE.—There are three forms of this affection which it is necessary to distinguish from each other, inasmuch as they differ greatly in the mode of treatment, and in the ultimate result. These are—1. Hysterical or Spasmodic Stricture; 2. Fibrous Stricture; 3. Cancerous Stricture.

1. **Hysterical or Spasmodic Stricture** is met with chiefly in young females under twenty-five, though it may occur in much older persons of the hysterical temperament. It is possible for it to occur without evident organic disease or change of any kind. But I believe that the simple and pure uncomplicated hysterical stricture is of very rare occurrence. In the majority of instances it will undoubtedly be found to be associated with and dependent upon some local change of structure, most commonly of a simple kind, such as chronic inflammation of the pharyngeal mucous membrane, ulcerative abrasion of it, or follicular inflammation about the epiglottis and posterior part of the larynx. The disease in many cases is supposed to be dependent on or originally occasioned by the patient swallowing some foreign body, as a fish-bone, bead, bristle, &c., which after many months is still thought to be impacted. This is almost always erroneous. The foreign body may have been swallowed, and may have been the starting-point of the slight inflammatory or ulcerative action that occasions the dysphagia, but it has long since disappeared, merely leaving a series of troublesome consequences in its train. The obstruction is generally high up in the pharynx, rather than in the œsophagus; being produced by the contraction of the constrictor muscles of the pharynx. The dysphagia is intermittent; when the patient's mind is allowed to dwell long on the affection, and she becomes anxious about it, then the difficulty is greatly increased; whilst at other times, when her thoughts are diverted from it, food passes easily. It will be found also, in these cases, that on attempting to pass a probang or large bougie, its progress will at first be resisted, but, by patiently and gently pressing down upon the stricture, the instrument will soon pass easily.

2. **Fibrous Structure.**—There are two kinds of organic stricture of the œsophagus—namely, the fibrous and the cancerous. Between these the diagnosis is often very difficult; strictures originally fibrous sometimes degenerating into or assuming a malignant form; while others continue fibrous from the first. The fibrous stricture is scarcely ever idiopathic. It almost invariably originates from the cauterisation of the interior of the œsophagus by the accidental or suicidal swallowing of some corrosive fluid, acid or alkaline, as the strong mineral acids or soap-leys, by which the mucous membrane is destroyed, charred as it were, and a cicatrix as of a burn forms. The etiology, in fact, is an important element in the diagnosis, the fibrous stricture being almost invariably the direct result of escharotic action, the cancerous occurring

without assignable cause, or being referred to some slight form of local irritation. Generally, on passing an instrument, we find that in the simple or fibrous stricture it passes smoothly, and gives no sensation of roughness, no feeling of lacerating its way, or as if it were passing over an ulcerated surface; no blood follows its withdrawal, and the patient does not bring up pus, or pus and blood, though there may be copious mucous discharge. There is no material enlargement of the neck, no swelling of the cervical gland, no sign of the cancerous cachexia.

3. **Cancerous Stricture.**—In the malignant or cancerous stricture the instrument seems to pass over a rough and ulcerated surface, its introduction is followed by blood, and the patient coughs up blood, or blood and pus, mixed often with shreds of tissue—conditions all indicating a loss of substance (Fig. 640). There is also, generally, an ovoid or elongated swelling at the root of the neck; the neighbouring glands may be affected; there may be cancerous tumours elsewhere; and the symptoms of the cancerous cachexia may be present. A fibrous stricture may, however, and very commonly does, degenerate into a malignant one—into epithelioma, though, perhaps, not into scirrhus or encephaloid. The special causes of cancer of the œsophagus are not known.

TREATMENT.—The treatment of stricture of the œsophagus will depend upon its nature. In the *hysterical variety*, the occasional introduction of a full-sized œsophagus-bougie, the application of belladonna to the neck, and antihysterical treatment generally, iron, aloetics, douches, and diverting the patient's mind from her malady, are the means to be employed. In such cases, Garrod has very advantageously employed large does of assafœtida.

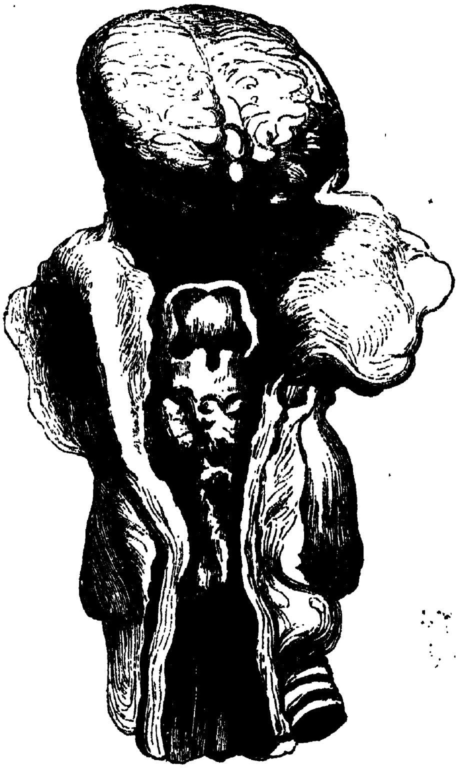

Fig 640.—Epithelioma of Pharynx and Œsophagus causing Stricture.

The treatment of **organic stricture** is more difficult. In it care should be taken that the patient is principally kept upon nutritious slops, or upon meat that has been well chopped up, as larger fragments are apt to become impacted at the seat of constriction. The difficulty in deglutition will, however, gradually increase, the patient being unable to swallow solids, then being reduced to pulpy food, and at last to liquid. After a time, he will not even be able to swallow these; and then it becomes necessary for the Surgeon to feed him by the introduction of a gum elastic catheter through the stricture, and the injection of a sufficient quantity of liquid or semi-pultaceous nourishment into the stomach twice a day. After a few weeks, the irritation induced by the repeated introduction of the catheter will render its passage more and more difficult, until at last it becomes impossible to get it through the constriction. The patient may still be kept alive for some weeks by nutritive enemata, but at last dies of exhaustion and starvation. Even in cancerous stricture of the œsophagus, death seldom occurs by secondary deposits, or by constitutional contamination, but in the way just pointed out. In some cases the disease extends to the posterior part of the larynx, the mucous membrane covering the arytenoid cartilages and the epiglottis becomes involved, laryngeal stridor and dyspnœa ensue, and death may result from laryngeal spasm, unless life be prolonged by tracheotomy, which in most cases becomes necessary.

Such is the miserable course and termination of an organic stricture of the œsophagus. But the question now presents itself, can nothing be done to cure or even arrest this disease ?

The **Palliative Treatment** that is usually adopted in these cases consists in the introduction of bougies, and an attempt to thus dilate the stricture exactly as in the case of a constriction of the urethra. In introducing bougies into the strictured part of the œsophagus, there is, however, often a good deal of difficulty in making the point of the instrument enter the narrowed portion of the canal. This is more particularly the case when the constriction commences suddenly ; the œsophagus, as is frequently the case, being dilated into a pouch-like sac above it, in which the food is apt to lodge, and the end of the instrument to be arrested, and at the bottom of which a narrow orifice exists, leading into the lower portion of the canal. In these cases, much patience and care may be required in overcoming the difficulty. Besides the ordinary dilatation by gradually increasing the size of the instruments used, I have in some cases seen temporary benefit result from the use of a catheter, surrounded by a tube of vulcanised India-rubber, which admitted of dilatation by the injection of water or air when introduced through the stricture ; or from the employment of a tubular instrument, by passing a long small-sized bougie through the constriction, and then slipping a gum-elastic catheter with a rounded terminal aperture over it. It is needless to observe that, in the treatment of stricture of the œsophagus with bougies, no force should be used, lest the walls of the canal be perforated.

From these means temporary relief may result in some cases ; but can an œsophageal stricture be thus cured ? I believe not. If the stricture were ordinarily fibrous, as in the urethra, a cure might possibly be expected. But this form of œsophageal constriction must be excessively rare ; and if the disease can be made out to be malignant, but little good, and most probably much harm, will result from the irritation of dilating instruments. We may, therefore, employ dilatation as a means of temporary benefit, but not with the hope of effecting a cure. Should the stricture at last become so tight as no longer to allow the catheter to be passed, and food to be thus injected into the stomach, the patient must inevitably die of inanition, unless kept alive by nutritive enemata. By these means I have known life prolonged, by a frail tenure it is true, for many weeks. In such cases it is an interesting physiological fact that, although the patients may continue to be moderately well nourished, and do not feel the pangs of hunger, they suffer excessively from thirst.

Has surgery no resource in those cases in which the stricture has become impermeable, and in which neither food can be swallowed nor a catheter passed, and in which, consequently, the most miserable death, death by starvation, is impending ? In such cases it has been proposed by Sédillot, to open the stomach by an incision through the abdominal walls, and thus directly introduce food into the organ. This operation has been practised several times by Sédillot, Fenger of Copenhagen, Forster, and others. Sédillot, who has given it the name of *Gastrostomy*, lays down the following rules for its performance.

**Operation of Gastrostomy.**—The patient lying on his back, the Surgeon, who stands on the right side, makes a crucial incision, each limb of which is about an inch and a half in length, on the left side of the mesial line of the abdomen, two fingers' breadth to the inner side of the costal cartilages, and about one-third nearer to the ensiform cartilage than to the umbilicus ; having previously satisfied himself by percussion and palpation that the liver is not in his way. The dissection is carried through the abdominal wall, and the peritoneum is opened. The Surgeon then feels with the left index finger for the left border of the liver ; by following this upwards, the stomach is reached. This organ is then seized with forceps, drawn forwards and examined, so that its identity may be established. By means of three or four points of suture, the anterior wall of the organ is then fixed to the edges of the aperture in the integuments, and an opening is made into it about midway between its two extremities, and a little above the lower margin. Nutritive injections must not be made into the artificial opening for the first few days ; not, in fact, until consolidation of the wall of the stomach to the parietal peritoneum has been secured, and a fistulous opening thus fairly established. This must be kept patent by properly adapted silver tubes, through which the nutritive injections are to be made.

The value of this operation has as yet to be determined by experience. In but few cases in which it has hitherto been done has it succeeded in adding much, if anything, to the prolongation of life. In reasoning upon it, two objections present themselves. First, there is the great and immediate danger of destroying life outright by the induction of peritonitis ; though it is by no means impossible that the tendency to abdominal inflammation may be lessened by the previous starvation of the patient. But supposing this risk to be overcome, what is gained by the artificial opening ? It is true that through it the patient might be nourished ; but, as every idiopathic stricture of the œsophagus is either from the first of a cancerous character, or eventually assumes a malignant action, of what advantage is it to endeavour to prolong a precarious existence, which must in a few weeks or months be cut short by the unchecked progress of a malignant disease ? Would not the immediate danger of the operation much more than counteract all good to be eventually derived from it ?

There is, however, one class of œsophageal strictures which are of the most obstinate character, and rapidly fatal by simple occlusion of the tube, without any tendency to malignancy. These are the constrictions that result from the swallowing of corrosive liquids, whether acid or alkaline. In such cases as these, in which speedy death by starvation is inevitable, I think that recourse might with propriety be had to the operation of gastrostomy.

## DISEASES OF THE LARYNX.

The larynx may be the seat of a great variety of morbid conditions. Acute, œdematous, and follicular inflammation; ulcerations and chronic thickenings of the mucous membrane; inflammation and necrosis of its cartilages; and the formation of tumours or polypoid growths in its interior, may all occur.

LARYNGOSCOPE.—It is of the utmost importance in the diagnosis, and for the proper treatment of many of these affections, that a view should be obtained of the parts that are the seat of disease. This can only be done by means of the **Laryngoscope.**

The introduction of this instrument into practice and its perfection have been a work of time.

It appears to have been invented and first used in 1829, by Babington, who, under the term "Glottiscope," described an instrument consisting of a small mirror fixed to a wire shank, which, being placed against the palate whilst the tongue was held down, enabled him to view the glottis and upper part of the larynx; more especially when he illuminated these parts by throwing reflected light upon them from a mirror held in his left hand. Liston, Trousseau, and Avery, all made attempts in the same direction. But it was the celebrated singer Garcia, who, by throwing the sun's rays into the back of his mouth from a mirror held in his left hand, and then introducing a dentist's reflector into his mouth, saw the image of his own larynx and studied its movements in the reflection of the looking-glass. Hitherto, however, laryngoscopy had not been employed in the study and diagnosis of diseases of the larynx, and it is undoubtedly to Czermak that the merit is due of having been the first to make this application of the art.

The *laryngoscope* essentially consists of two instruments, a reflector (Fig. 641), which may be attached by an elastic band to the Surgeon's forehead, and a mirror (Fig. 642), which is held in his right or left hand, according to circumstances.

The mode of application and of use is extremely simple, and is illustrated in Fig. 641. The patient sits with his back to a good light; that of the sun does very well if it can be obtained; but usually artificial light has to be employed. This may be obtained from a moderator or paraffin lamp. The flame of the lamp should be a little above the level of the patient's ear. The Surgeon, facing the light, arranges the mirror in such a way that, whilst both he and the patient are in easy positions, a well defined circle of light covers the patient's mouth. If, as in many arrangements, the mirror be over one eye of the Surgeon, he must so place it that he sees clearly through the hole in the centre, and can consequently employ both eyes in examining the throat. The patient now having the head very slightly inclined backward, opens his mouth and puts out his tongue. The Surgeon grasps the tip of the tongue gently between the fore-finger and thumb of his left hand, covered by a cloth or pocket-handkerchief. He must be careful not to drag on the tongue, but merely to hold it steady; and this is best accomplished by resting the fore-finger on the patient's chin. He now takes the small mirror and warms it over the lamp, so that the patient's breath may not condense on it and obscure the image of the larynx. Having warmed it till he sees the cloud of condensed moisture from the lamp disappear, he tests it against his own cheek to feel that it is not too hot, and then introduces it in the following way. The handle being held like a pen, and rather to the left side of the patient's mouth, the mirror is passed in carefully, having its surface parallel to the dorsum of the tongue, until the tip of the uvula rests on its back, and is pushed slightly backwards and upwards by it. Care must be taken, in doing this, that the reflecting surface does not touch the tongue, and so become dirtied, and that the mirror is not passed so far as to touch the back of the pharynx, which in most patients would cause an effort at swallowing. The mirror being in the position above described, the Surgeon will, if he see anything, view the back of the pharynx reflected on its surface; but, by gently and steadily raising his hand, so as to render the angle formed by the surface of the mirror with the patient's body about half a right angle, he will bring the opening of the glottis into view. By raising the hand still a little further, he can examine the epiglottis and the root of the tongue. It must be remembered that the image thus produced is reversed in the antero-posterior direction, the parts that appear anterior on the mirror being really posterior; while in the transverse direction there is no reversal.

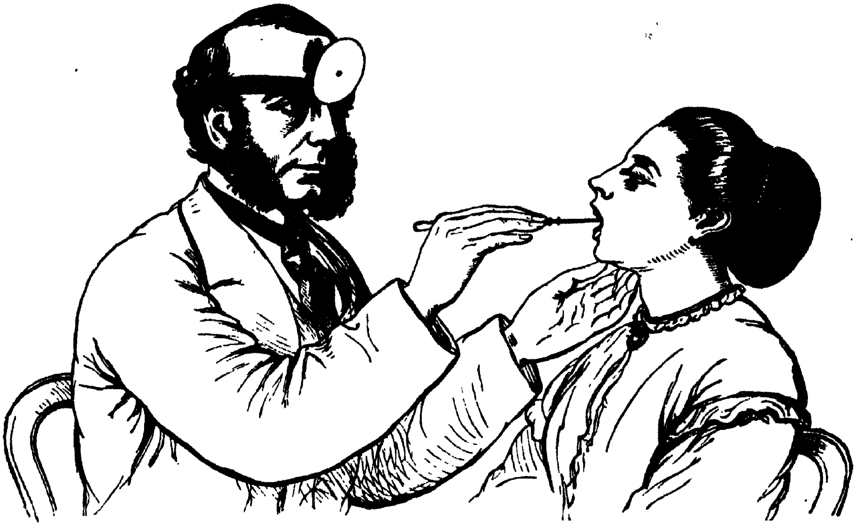

Fig. 641.—Application of the Laryngoscope. The tongue should be drawn forwards.

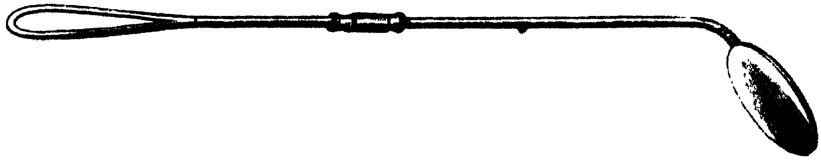

Fig. 642.—Throat Mirror.

When the Surgeon requires both hands, as in the application of caustics or in the removal of growths or foreign bodies, the patient must be made to hold his own tongue, or it must be held by an assistant. The Surgeon then holds the mirror in his left hand, and the instrument he is using in the throat in his right. Sometimes all view of the larynx is obscured by the patient obstinately arching the tongue in the mouth. It must then be held down by a spatula. In some patients, the fauces are so irritable that the slightest touch causes violent retching. This may be allayed by sucking ice for a short time before the laryngoscope is employed.

LARYNGITIS.—Inflammation of the larynx principally occurs in adults, from exposure to cold, to the infection of erysipelas, or to the general occasioning causes of the low forms of inflammation. It differs essentially from the croup of children, which is attended by an albuminous exudation, and spreads downwards into the bronchi; whilst in laryngitis there is no effusion of plastic matter, and the disease is confined to the larynx itself. Laryngitis may not only be of an acute or a chronic kind, but the acute form likewise presents two distinct varieties, according to the parts affected, the cause from which it arises, and the condition of constitution in which it occurs: in one, the true **Acute Laryngitis**, the inflammation is chiefly seated in the mucous membrane; in the other, the **Œdematous Laryngitis**, the affection chiefly occurs in the submucous areolar tissue, within and around the larynx.

In all inflammatory affections of the larynx, whether acute or chronic, there is great danger to life; the rima glottidis, that narrow chink through which all the air destined for respiration must enter, becomes readily occluded, and asphyxia consequently results. This may happen either by the swelling of the lips of the glottis, from the effusion of plastic matter within or upon them; or by the occurrence of spasm in the larynx; indeed, there is always more or less spasm conjoined with all the inflammatory affections of this part of the air-tube; and this spasm, being superadded to already existing mechanical occlusion, commonly proves fatal. These laryngeal spasms do not at first recur oftener than at intervals of half an hour or an hour; but as the disease advances they become more frequent, and in any one of them the patient may be carried off. It is of importance to bear in mind that death may occur in these cases, although a considerable portion of the cavity of the larynx continue free. Thus Cheyne states that there are always in croup at least three-eighths of the cavity of the larynx open for the transmission of air; and that death must consequently result from some other cause than mere mechanical obstruction. This freedom from permanent occlusion commonly occurs in cases of laryngitis; and the immediate cause of death in the majority of instances appears to be spasm, conjoined with defective arterialisation of the blood, which, becoming dark and poisonous, causes congestion of the lungs or brain, and thus low pneumonia and convulsions.

**Acute Laryngitis.**—The *Symptoms* are those of local inflammatory action of an acute kind, conjoined with those of interference with the proper admission of air to the lungs. The mucous membrane is the part principally inflamed, and but little effusion takes place under it; hence the symptoms are not always indicative of such early or intense interference with respiration, as is met with in the œdematous form of the disease. In acute laryngitis there are pain and tenderness on pressing upon the larynx, more especially about the pomum Adami. The voice at first is harsh and rough, then stridulous or sonorous; and deglutition becomes difficult. There is expectoration of frothy mucus, sometimes tinged with blood. With the laryngoscope the intensely injected state of the mucous membrane of the larynx can be seen; but this is not accomplished without difficulty, partly from the irritability of the fauces, and partly from the large amount of tenacious mucus which usually surrounds the glottis. The difficulty in swallowing is often at first the most prominent symptom, and continues throughout; dyspnœa, often of a spasmodic character, then appears, the lips becoming livid, the features pale and bedewed with perspiration, the eyes watery and bloodshot, and the respiratory muscles being called into violent action; the nostrils are dilated; gasping efforts at breathing, and sudden fits of increased difficulty in inspiring come on; at the same time the pulse becomes feeble, though it continues rapid; and, unless efficiently relieved, the patient will speedily sink. When it proves fatal, the acute usually runs into the œdematous form of laryngitis.

*Treatment.*—The treatment should be actively antiphlogistic. No time must be lost, otherwise the patient will fall into a hopeless state of asphyxia. Free blood-letting, the application of an abundant supply of leeches to the larynx, and the administration of calomel in large doses, with antimonials, must be employed. If, notwithstanding the administration of these remedies, the difficulty in respiration continue to increase, the windpipe must be opened before the lungs and brain become irretrievably engorged. It is no easy matter to determine when it is no longer prudent to trust to active antiphlogistic treatment, and when recourse should be had to operation; indeed, the determination of this point may be considered as one of the nicest questions in surgery. As a general rule it may be stated that if, notwithstanding the antiphlogistic means above indicated, the dyspnœa become gradually more urgent, and the paroxysms of spasmodic difficulty of breathing more frequent and severe, then no time should be lost in the performance of the operation, for however short a period the disease may have existed. I can truly say that I have seen several cases lost by delaying the performance of this operation, but never one by opening the windpipe too early. Indeed, if the opening be even made somewhat early, I do not think that much if any harm results, as the larynx is thereby set at ease; and, on the laryngitis being subdued by the continuance of proper treatment, the aperture, which has simply served as a breathing-hole, may be allowed to close by granulation.

**Œdematous Laryngitis** is seated chiefly, if not entirely, in the submucous areolar tissue, and frequently comes on in the course of chronic affections of the larynx. It may, however, be of a distinctly erysipelatous character, occurring as the result of exposure to infection, or to atmospheric vicissitudes. In fact, in many cases it appears to be at times epidemic, and in its pathological conditions resembles closely phlegmonous erysipelas of the part; the mucous membrane becoming red, pulpy, and swollen, and the areolar tissue lying beneath it infiltrated with semi-puriform plastic matter. In this form of the disease, the fauces are reddened, dusky and swollen; there is much and early dyspnœa; the voice becomes hoarse, rough, and speedily extinct; deglutition becomes very difficult; and, on passing the finger over the back of the tongue, the epiglottis will be felt rigid and turgid. There may be some degree of tenderness about the larynx; but the local symptoms, which are less acute, are attended by a greater amount of dyspnœa than in the acute form of laryngitis. The dyspnœa is usually peculiar in character in the intervals between the spasms. Inspiration is always more or less difficult, as the swollen and œdematous parts fall together in a valve-like manner over the opening of the glottis. Expiration is, on the other hand, comparatively easy. In œdematous laryngitis there is also a good deal of spasm associated with the local turgescence. The spasms sometimes come on early, and carry off the patient at once. They are very apt to be brought on by speaking or swallowing; but, as the disease advances, the dyspnœa may become more continuous, with great restlessness, a quick, small pulse, and convulsive breathing, the countenance being pale, sunken, and clammy, and the eye dull. Stupor at length supervenes, and speedily terminates in death.

The œdematous infiltration in this form of laryngitis is principally confined to the submucous areolar tissue around the epiglottis, at the margins of the glottis, and to that which lies at the back of the thyroid cartilage. In these situations the tissue is distended with sero-plastic fluid, of an opalescent appearance, so as almost completely to occlude the rima glottidis (Fig. 643). It is a pathological fact of much importance, that this effusion never extends below the true vocal cords, being limited at this point by the direct adhesion of the mucous membrane to the subjacent fibrous tissue, without the intervention of any areolar membrane.

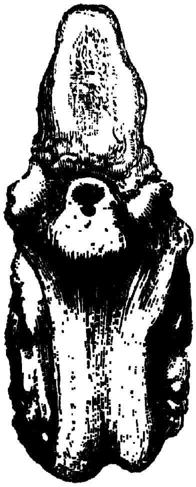
Fig. 643.—Œdema of the Glottis.

*Diagnosis.*—It is of great importance to make the diagnosis between the two forms of laryngitis. In the acute variety of the disease, antiphlogistic treatment is of great moment; in the œdematous form it is comparatively useless, for here effusion sets in early, and nothing is left for the Surgeon but to open the air-passage, so as to give the patient breathing-room, whilst the disease is being subdued. The laryngoscope is of the greatest use in arriving at a correct diagnosis. It is somewhat difficult to use in these cases, especially if there be much dyspnœa, but supposing even a momentary glance be obtained of the opening of the glottis, the condition depicted in Fig. 643 may readily be recognised. In addition to this, the epidemic character of the affection, the absence of much pain in the larynx, and the dusky-red and swollen fauces, will point to the œdematous variety. Then, also, the effect of antiphlogistic treatment should be taken into account. If, after its active employment, no alleviation of the symptoms occur, it is only reasonable to suppose that the obstruction to breathing is owing rather to a purely mechanical obstacle than to simple inflammation.

*Treatment.*—The treatment of œdematous laryngitis must be antiphlogistic though the constitution will not usually bear any very active measures. Leeching under the jaws and over the larynx, with the administration of antimonials and salines, will be especially serviceable. In many cases, scarification with a hernia-knife or probe-pointed bistoury about the root of the epiglottis, the sides of the glottis, and the back of the thyroid cartilage, will be found the most ready means of unloading the infiltrated mucous membrane. The operation of scarification may be more accurately performed by using the laryngeal lancet, whilst the glottis is brought into view by the use of the laryngoscope. In these cases, however, it is especially necessary to open the windpipe before it is too late, and the lungs have become engorged. After the proper employment of the means that have been indicated and their failure, the less delay there is in opening the air-passage through the crico-thyroid membrane, the better. The Surgeon should not wait until extreme and continuous dyspnœa has set in; this may never occur, the difficulty in breathing being rather spasmodic than continuous, and in one of the spasms of dyspnœa life may suddenly become extinct. The lungs may become fatally congested, if the difficulty in breathing be allowed to continue too long. The operation adds but little to the patient's danger, but the increased risk is immense if it be delayed to an advanced period. Not unfrequently this operation is delayed until too late; there is, I think, more risk of doing this than of opening the windpipe too early. When once dyspnœa with laryngeal spasm has fairly set in, every moment is precious, and the patient may at any time be carried off by the recurrence of the spasmodic seizures. The patient does not die gradually asphyxiated, but is suddenly seized with a spasm that terminates his existence.

If the œdematous laryngitis become chronic, sloughing and putrid suppuration of the submucous areolar tissue may occur, as in phlegmonous erysipelas of other parts of the body, and the patient may die partly from asphyxia and partly from typhoid symptoms, with putridity of the breath and mouth. In these cases the administration of stimulants and tonics, more particularly port wine and bark, with free sponging of the part with a strong solution of nitrate of silver, will be urgently required.

**Chronic Laryngitis.**—The larynx is liable to various chronic diseases of a serious character, some of which are incurable, leaving a permanent impairment of the vocal and other functions of the larynx. Those affections present great variety: and many give rise to *Aphonia*, or loss of voice. Chronic laryngitis may arise from cold in relaxed and debilitated subjects, or after prolonged over-exertion of the voice in speaking or singing. This form is common amongst clergymen, and hence is familiarly known as the *Clergyman's Sore-Throat;* it is also of frequent occurrence amongst singers, but may be met with among all classes of the community. Other forms arise from deposit of tubercle, or in connexion with tubercular disease of the lungs; and others, again, as the result of syphilis. In fact, so common are these two causes, that in all cases of chronic laryngitis not arising as the direct result of over-exertion of the voice, one or the other of these diseases should be suspected and carefully searched for.

*In simple chronic laryngitis* the voice at first becomes hoarse, and afterwards reduced to a whisper. There is an increased secretion of mucus, and the patient is constantly troubled by a tickling or spasmodic cough, and at the same time there is usually a feeling as if there were some constant cause of irritation in the throat, attended by a desire to cough up and expectorate. Examination, by means of the laryngoscope, shows the mucous membrane of the throat congested, relaxed, and thickened. The true vocal cords have lost their sharp edges, and are somewhat rounded, and at the same time, instead of the pure white colour natural to them, they are usually of a pink tint. Occasionally small wart-like growths may appear on the vocal cords or elsewhere, as the result of simple chronic laryngitis.

In the *tubercular* variety the symptoms are at first much the same as in the simple: but as the disease advances, the expectoration becomes more and more puriform, the cough increases, the patient emaciates, is affected with night sweats, and at last sinks and dies. This variety is often spoken of as *Laryngeal Phthisis.* In this form of the disease, a marked feature, as seen by the laryngoscope, is the rounded thickening of the arytænoid cartilages, accompanied by a similar condition of the arytæno-epiglottidean folds of mucous membrane. Patches of ulceration, often having a white or a yellowish surface, form later in these parts. The epiglottis is usually congested, but not extensively ulcerated. Ulceration and thickening of the vocal cords are also common. When the affection is at all advanced, disease of the lungs is almost invariably present, and it is only in rare cases that the larynx is affected first.

In the *syphilitic* variety the symptoms much resemble the tubercular, but the constitutional condition is different, and the lungs remain healthy. The laryngoscope shows us also that the local appearances are not exactly the same. The epiglottis is often extensively affected, in some cases being completely destroyed. The swollen rounded condition of the tips of the arytænoid cartilages, common in tubercular laryngitis, is not so marked. At the same time the ulceration frequently extends to the pharynx, and ulceration, or the scars of old ulcers, may be seen on the tonsils. The vocal cords are often more or less completely destroyed, and not unfrequently the disease leads to necrosis of the laryngeal cartilages (see p. 553). The syphilitic form of ulceration gives rise in many cases to narrowing of the glottis, and tracheotomy is much more frequently required in this variety than in the tubercular.

*Diagnosis.*—Examination of the larynx by means of the laryngoscope will always serve to point out the true nature of the affection, and to prevent its being confounded with chronic bronchitis or catarrhal attacks; and attention to the points above indicated, with a careful inquiry into the constitutional condition of the patient, together with a stethoscopic examination of the chest, will usually determine the variety of the disease from which he is suffering.

*Treatment.*—The treatment of the various chronic inflammations of the mucous membrane of the pharynx and larynx requires to be conducted by careful regulation of the general health and selection of climate, avoidance of exposure to cold, and attention to digestion; and especially by the local application of various astringent vegetable and metallic solutions.

In the milder forms of the disease, a saturated solution of tannin or glycerine, applied by means of a camel's hair brush or a sponge-probang, will be found useful. In many cases the best results follow the inhalation of solutions of tannin or sulphate of zinc in a "pulverised" form, applied by means of the ordinary spray-douche, such as is used for procuring anæsthesia by the local application of ether. But of all these astringents none equals in value the **topical application of a solution of the nitrate of silver,** which may almost be looked upon as specific in the simpler forms of this disease.

The practice of treating chronic disease of the larynx by the application of a strong solution of the nitrate of silver is by no means of recent origin. Many years ago it was employed by Sir C. Bell; and before him Bretonneau applied the solution in these cases by means of a sponge attached to a piece of whale-bone. Of late years this practice has been brought very prominently before the profession by Trousseau, and by the American Surgeons, especially Horace Green and J. Warren.

Of the great value of this treatment in laryngeal disease, there can be no doubt. I believe it to be almost impossible to bring deeply seated and very chronic inflammatory or ulcerative affections of this part of the air-passages to a satisfactory termination by any other means. The mode of application that is the simplest and is very effectual, consists in depressing the tongue with a proper spatula, and then passing a throat-sponge, consisting of a small piece of this material firmly attached to a curved whale-bone stick (Fig. 644), and saturated with a solution of nitrate of silver, down to the parts that are diseased, so that the liquid may be applied to the whole of the affected surfaces. By the help of the laryngoscope, the solution may be very accurately applied to the inflamed part by means of a large camel's-hair pencil, firmly attached to a piece of wire bent to the proper angle, and set in a bundle. This solution should vary in strength from half a drachm to a drachm of the salt to an ounce of distilled water; most commonly, the latter strength will be most useful. This plan of treatment has been much practised of late years in this country, and with considerable success in a large number of cases. Some of its advocates, however, not content with curing in this way disease that is visibly seated in the throat, state that the morbid action extends down the trachea into the bronchi, and that it is necessary to follow it in these situations. They accordingly speak of passing the probang or brush between and beyond the vocal cords, and of sponging and mopping out the interior of the larynx and the lower parts of the air-tube, and of applying the caustic solution to them, as if this were a proceeding that could be adopted with as little difficulty as passing the sponge into the nares. I cannot believe, however, that this practice, though commonly spoken about and professedly employed, is ever in reality carried out. Any one acquainted with the physiology of the larynx knows how acutely sensitive it is, and how it resists the introduction of any foreign body by the most violent spasmodic fits of coughing, in its normal state; and any Surgeon who has seen the effects resulting from the fair and complete inhalation of a drop or two of solution of nitrate of silver in a morbid and irritable condition of this tube, must feel sure that no sponge saturated with a solution of this caustic could ever have been thrust down between and beyond the vocal cords into the trachea and bronchi.

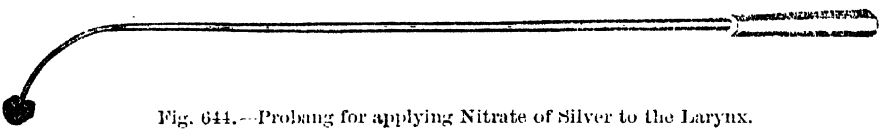

Fig. 644.—Probang for applying Nitrate of Silver to the Larynx.

The utmost that can be done is that, guided by the laryngoscope, a small brush may be momentarily passed between the vocal cords, but the spasm so caused renders it impossible to do more. Other instruments have also been passed beyond the true cords, and warty growths have been in this way removed from the cords themselves; but the moment they are touched, spasm occurs. The most that can be done is a sudden touch of a brush or snatch with a forceps or loop of wire. Any more deliberate proceeding is impossible.

**Inhalation of the Nitrate of Silver in Powder** is most conveniently done by mixing it, in proper proportions, with some innocuous impalpable powder, such as ground and dried sugar. The strength may vary; one part of nitrate of silver being mixed with twelve, sixteen, or twenty of sugar. A small quantity of the powder so prepared should be put into the end of a thick glass tube, which has been bent nearly at right angles, about one inch from its extremity. The Surgeon, placing his finger over the orifice of the straight part of the tube, carries the bent end behind the tongue, over the epiglottis; he then directs the patient to make a sudden inspiration, and at the moment of his doing so takes away his thumb, so as to allow the powder to be drawn out of the tube and into the air-passages along with the current of inspired air. In this way the nitrate of silver may, in some cases, be very conveniently applied to the whole of the affected mucous surfaces without the irritation produced by the friction of the sponge.

**Injection of the Solution of Nitrate of Silver** may easily be done by means of the instrument that is here delineated (Fig. 645), and which I have had constructed for this purpose. It consists of a silver tube, perforated at the end, and having a small piston moving in it with a sponge attached to its lower surface. The instrument is charged by dipping the end in the solution, and then drawing back the piston-rod. It is then passed into the pharynx, or between the lips of the glottis, and the fluid is injected into the air-passages or upon the inflamed surfaces in a number of fine streams, by pushing down the piston and compressing the sponge. By means of this *laryngeal syringe* the nitrate of silver can be applied to any part of the pharynx, without irritating the tender mucous membrane by the contact of a rough body; and, by applying its nozzle to or between the lips of the glottis, the fluid may be readily thrown down into the interior of the larynx with the greatest certainty and ease. In those cases in which it is wished to apply the solution of the nitrate of silver to the air-passage, I greatly prefer using this simple instrument to the ordinary sponge, the mere pressure of which upon a tender mucous surface may be a source of irritation. When the mucous membrane behind the velum, or that of the posterior nares, is affected, the solution may readily be applied to these parts by turning the end of the instrument upwards, and then injecting it directly on to the affected surfaces.

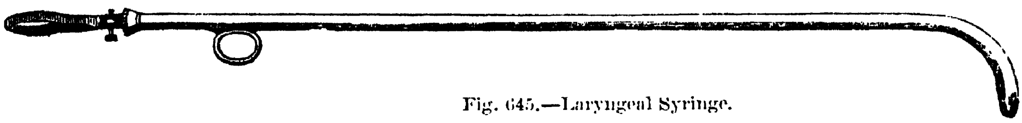

Fig. 645.—Laryngeal Syringe.

In whatever way the caustic is used, its application should be repeated about every second or third day, in order to insure its full effects. In some instances, however, advantages may be obtained by using it every day; in others, again, a longer interval is required than that just stated.

**Results of Chronic Laryngitis.**—In the more advanced forms of chronic disease of the larynx, the submucous areolar tissue becomes infiltrated with **Plastic Deposits.** The mucous membrane itself becomes swollen, congested, and ulcerated in patches; vegetations form, perhaps, at some parts, and deep ulceration takes place at others, so that the whole surface becomes irregular and loses its natural smoothness. These morbid appearances are not confined to any one part of the larynx, but may occupy any portion of that organ above the vocal cords. The large plane of mucous membrane covering the arytænoid and the posterior part of the thyroid cartilages especially becomes involved. The epiglottis becomes thickened and rigid, and the rima glottidis is narrowed. The pharyngeal mucous membrane becomes implicated, respiration is croupy, stridulous, and harsh, deglutition difficult, and there is abundant muco-purulent expectoration, and wasting of the body. These diseases are often of syphilitic origin, and, after continuing for some length of time, give rise to hoarseness, cough, shortness of breath, a pale, pasty, and œdematous look about the face, with suffused eyes and constant difficulty in breathing. In these circumstances there is a constant tendency to acute inflammation supervening on the chronic laryngeal disease ; and the affection commonly proves fatal by the induction of œdema glottidis, often coming on with great rapidity.

**Necrosis of the Cartilages of the Larynx** not unfrequently happens in the more advanced forms of this affection, attended by all the signs, constitutional and local, of the so-called *Laryngeal Phthisis,* and by the expectoration of large quantities of fetid puriform sputa, often streaked with blood, and occasionally containing masses of the necrosed and disintegrated cartilage. In many cases **Abscesses** form outside the tube, and after much irritation and distress open externally ; and not unfrequently they are met with to such an extent, as to undermine and disorganise the greater portion of the tissues of the anterior part of the neck. Where they correspond to the necrosed patches of cartilage, they give rise to aërial fistulæ, through which bubbles of air escape during respiration.

*Treatment.*—In the treatment of these more severe diseases of the larynx, the daily application of nitrate of silver will be found of great benefit. It should be freely applied to or injected upon the mucous membrane about the epiglottis, within the lips of the glottis, and more especially that loose and filamentous tissue which is extended over the back of the thyroid cartilage, and which is commonly the seat of much chronic irritation, and the chief source of the muco-puriform discharge. At the same time, the internal administration of bichloride of mercury with sarsaparilla will often be found of great service, more particularly in those cases in which the disease is of a syphilitic character ; the patient being kept in a regulated temperature, not allowed to exert his voice, and avoiding all laborious exertion. In cases of long-standing and otherwise apparently incurable laryngeal disease, accompanied by ulceration of the mucous membrane, chronic muco-purulent discharge, loss or modification of voice, and wasting—in fact, in that condition termed laryngeal phthisis,—it has been proposed by Bryant to perform tracheotomy with the view of giving the diseased organ rest, and thus giving time and opportunity for the inflamed and ulcerated mucous membrane to heal ; the operation being performed here, not for the relief of laryngeal obstruction, or with the view of rescuing the patient from impending death from asphyxia, but with the object of aiding other curative means in an otherwise intractable disease. This suggestion appears to be founded on sound pathological principles, and is of peculiar importance when we consider that patients suffering from chronic laryngeal disease are never safe from the sudden supervention of œdema glottidis. Whenever acute inflammation supervenes in these cases, with a tendency to œdema about the glottis, the patient should be narrowly watched, as he may readily be carried off by the sudden swelling of the lips of the rima, or by the supervention of spasm. In cases of this kind, the air-passage may be required to be opened to allow respiration to be carried on; and this operation must not be delayed until such time as the patient falls into an asphyxial condition.

NERVOUS AFFECTIONS OF THE LARYNX occur both in children and in adults. In *children* the affection, commonly called **Spasmodic Croup**, comes on suddenly and runs its course with great rapidity. The child is seized, often without previous warning, with difficulty in breathing, uses violent efforts to inspire, becomes black in the face and convulsed, and may die before anything can be done for his relief. In other instances he gapes and gasps a few times, and eventually recovers himself with a long deep-drawn whooping inspiration. In cases of this kind, the *Treatment* at the time of the fits consists in dashing cold water in the face, in exposing the body to a current of cold air, and in using friction to the extremities. If asphyxia occur, artificial respiration must be kept up either through an opening made in the windpipe or by the mouth.

In the *adult*, these spasmodic affections of the larynx may come on either from pure hysteria, or from irritation of the laryngeal nerves by the pressure of tumours or aneurisms upon them. In other instances they arise from the presence of some local inflammatory mischief about the glottis. In the hysterical form of the affection the ordinary remedies for hysteria, together with cold douches, will be of essential service. In some cases, however, the obstruction to respiration is so great, that the Surgeon may almost think it necessary to have recourse to operation. When the disease arises from irritation to the trunks of the nerves, such a procedure is seldom justifiable, as the occasioning cause is usually in itself of a fatal character.

EXTIRPATION OF THE LARYNX.—Billroth has twice performed this operation for cancer. The first case survived, the second died. The operation has also been done by Langenbeck, Schmidt, Heine, and Bottini. It appears to me to be at best a barren triumph of surgical skill. If it be done to cure the patient of the cancer, it will necessarily fail in that object; if it be done to relieve him of sufferings arising from obstructions to breathing, irritative cough, &c., then these objects would certainly be more safely, and probably be quite as effectually attained by tracheotomy.

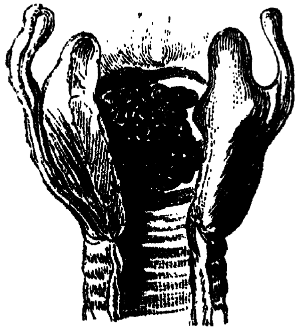
Fig. 646.—Epithelioma in Larynx.

TUMOURS OR POLYPI occasionally form in the larynx. They are commonly granular, or small cauliflower-looking bodies, though they occasionally attain the size of a hazel-nut. In structure they are usually epithelial, occasionally fibrous, and eventually may become cancroid (Fig. 646). They necessarily produce aphonia, interfere with respiration, and at last may give rise to asphyxia by obstructing the cavity of the larynx.

These tumours, which formerly could neither be recognised with certainty during life, nor treated effectually, have in recent years not only had their existence demonstrated by means of the laryngoscope, but have been removed by Walker of Peterborough, Gibb, G. Johnson, and Morell Mackenzie, in this country, and by Moura-Bourouillou of Paris, and other continental Surgeons. Gibb, in cases of this kind, succeeded in passing a loop of silver wire round the bases of two such growths, lying just within the true vocal cords, and then detaching them by drawing the wires through a steel cannula, and so tightening the loop. This ingenious operation has been performed several times with the aid of the laryngoscope. *Thyrotomy* has been performed in some cases. This operation consists in opening the trachea and introducing a trachea-tube, so as to enable the patient to breathe during the operation and during the after-procedure. The crico-thyroid membrane is then punctured, the thyroid cartilage slit up exactly in the median line, and the growth thus extracted by what appears to be and is a formidable operation, but which has hitherto been attended by successful results. After the operation the parts are accurately brought together, and the *trachea-tube is retained* until the patient can breathe through the glottis with ease.

# CHAPTER LX.

## OPERATIONS ON THE AIR-TUBE AND ON THE CHEST.

### LARYNGOTOMY AND TRACHEOTOMY.

THE windpipe may either require to be opened to allow the formation of a temporary breathing aperture, in consequence of the obstruction of the larynx by causes that are speedily removable; or it may be necessary to establish a permanent opening in the air-passage in those forms of chronic laryngeal disease, in which the obstruction depends upon organic alterations of structure which are not remediable.

Among the conditions requiring *temporary aperture*, may be mentioned all acute inflammatory affections of the larynx that give rise to obstructive œdema of the glottis; also traumatic conditions, such as the impaction of masses of food in the gullet, inducing asphyxia, and not capable of being immediately removed; scalds of the rima glottidis; the presence of foreign bodies in the air-passage; and œdema of the glottis from wounds of the thyro-hyoid membrane.

The establishment of a *permanent aperture* in the air-passage is especially required in chronic diseases of the larynx, attended by thickening of the mucous membrane, by abscess, or by necrosis of the cartilages—in fact, by any such conditions as do not admit of removal; so also, in cases of epithelioma or warty growth of the larynx, a permanent opening below the obstructed point may be required.

**Opening the Windpipe in Croup and Diphtheria.**—The question as to whether the windpipe should be opened in cases of **Croup** has been much discussed. Were croup merely a disease of the larynx, and did death in it result from simple laryngeal obstruction, it would doubtless often be proper to perform this operation. But in croup there are two distinct sources of danger: 1, that arising from asphyxia dependent on laryngeal inflammation, obstruction by plastic deposits, and spasm; and 2, that which is due to the extension of inflammatory action below the larynx into the bronchi and lungs. By tracheotomy we can doubtless remove so much of the danger as arises from the laryngeal obstruction, but we cannot remove that which is dependent on the often concomitant broncho-pneumonia. In this respect, the propriety of performing tracheotomy in the croup of children differs remarkably from the expediency of having recourse to the same operation in the acute laryngitis of adults, in which the lungs are rarely implicated to a serious extent. In fact, the question as to the performance of tracheotomy in the croup of children must be answered by the amount of laryngeal asphyxia and the extent of pulmonary implication. If the child be in danger of death from uncomplicated laryngeal inflammation, obstruction, and spasm, timely tracheotomy will undoubtedly rescue it from this immediate danger, and will be a proper operation; but, if extensive broncho-pulmonary inflammation already exist, it will be worse than useless, and should on no account be practised. A serious objection to the performance of tracheotomy in the croup of young children is, that it is by no means an easy operation or one devoid of immediate danger. If chloroform be not given, the struggles and writhings of the child will materially embarrass the Surgeon in his attempts at opening the windpipe. But even if chloroform be administered, which should always be done when practicable, and this source of difficulty removed, there is, unless care be taken, no little danger of hæmorrhage; and I have heard of several cases in which this has occurred to a fatal extent. Although, therefore, as a general rule, I fully agree with Porter in reprobating this in ordinary cases of croup, yet cases are doubtless occasionally met with, in which the disease is so clearly limited to the larynx—the respiration being free throughout the lungs and bronchi—that the Surgeon may feel himself justified in endeavouring to save the little patient, struggling against overpowering asphyxia, by opening the windpipe. In several such cases, to which I have been called by other practitioners, and which were apparently most favourable to the operation, I have considered myself justified in doing this, though rarely with ultimate success. I believe that the general experience of British Surgeons is unfavourable to the operation. On the other hand the French Surgeons, and more particularly Trousseau, are strenuous advocates for the performance of tracheotomy in croup, and the operation is accordingly far more extensively practised in France than in this country. But even in Paris it is not a very successful procedure; thus it appears that, at the Hospital for Sick Children in that city, the operation was performed in 215 cases in five years, and that of these only 47 were cured. Unless we assume that the disease, as occurring in Paris, is different from the form of croup we meet with here, it may fairly be doubted whether an operation which is in itself dangerous could be necessary in many of these instances, and whether a large proportion of the children might not have recovered under ordinary medical treatment and without having recourse to surgical operation.

In **Diphtheria**, as in croup, there are several sources of danger. There is not only peril from the obstruction of the pharynx and larynx, by inflammation and the accumulation of exudation-matter, to such an extent as to induce asphyxia, but there is also liability to pulmonary inflammation and congestion, blood-poisoning, and exhaustion of the system. In diphtheria, as in croup, the windpipe may be opened when the patient is in imminent danger of death from laryngeal obstruction; and the fatal event may be warded off so far as it arises from this cause, and time be then afforded for proper treatment. Even though the relief afforded by operation be only temporary in the majority of cases, and the patients generally eventually die of the constitutional symptoms, yet it is obviously proper in cases still uncomplicated, and where the danger of death from laryngeal asphyxia is imminent, that the Surgeon should rescue the patient from its instant peril, and give him his only chance of prolonging or of preserving life, by opening the windpipe,—the trachea in children, the larynx in adults, being most suitable for operation. It has been very justly observed by Sir W. Jenner that, by opening the windpipe in these cases, we save the patient from so terrible a death as that by asphyxia; and, even if life be ultimately extinguished by the disease, temporary ease will have been afforded the patient, and death will occur in a less distressing manner; and that, if only one life in a hundred could in this way be saved, we should be justified in having recourse to the operation. Sir W. Jenner has made the important observation, that if the larynx be not invaded by the end of the first week, so as to require the windpipe to be opened, laryngeal obstruction rarely if ever occurs.

The prospect of saving life after opening the windpipe in cases of diphtheritic asphyxia will greatly depend upon the age of the patient. Under two or even three years of age, recovery is extremely rare; as age advances, the chance of life proportionately increases, and in adults the prospect of recovery is considerable. In many cases the patient will get great temporary benefit from the operation, and will appear to be doing well for several days, perhaps for eight, ten, or fourteen; and then, to the great disappointment of the Surgeon, he will die, not from the effects of the operation, but from blood-poisoning or from the extension of the disease to the bronchi and lungs.

After operations of laryngotomy or tracheotomy in croup and diphtheria, it is a question how long the tube should be left in. As a general rule, I think from three to four days are sufficient, care being taken to cleanse it thoroughly during this period. After withdrawal, respiration will in a great measure be carried on through the aperture, which will not gradually close. Should this prove insufficient, the tube may always be inserted again. Occasionally false membranes are expelled, or may be withdrawn from the opening in the windpipe; and through it the interior of the larynx may be sponged out with solution of nitrate of silver, if thought desirable.

No patient ought ever to be allowed to die from simple laryngeal obstruction, whether that be spasmodic or dependent on organic disease, without an attempt being made to save life by opening the windpipe. It is as unpermissible for a Surgeon to allow a patient to die of laryngeal asphyxia without an attempt at relief by opening the windpipe, even though life appear to be extinct, as it would be to let him die of hæmorrhage without attempting to contract the bleeding vessel.

**Necessity for Promptitude.**—When it has been determined to open the windpipe for acute disease, more especially supervening on chronic laryngitis, the less delay there is in having recourse to operation, the better; as the patient may at any moment be seized with laryngeal spasm, and be carried off. The operation ought always, however, to be completed, even though the patient have apparently expired before the windpipe has been opened; for resuscitation may, even in these extreme cases, be effected by artificial respiration. When life hangs on so slender a thread as it does in urgent cases of laryngeal obstruction, the first touch of the knife may cause a spasmodic seizure that may give rise to apparent death. It has twice happened to me to operate under such circumstances, and in both cases to be fortunate enough to save the patient's life. In one case to which I was called many years ago by my friend Mr. E. Baker, the patient, an elderly woman, was apparently dying from the supervention of acute upon chronic laryngeal disease. I lost no time in making an incision into the crico-thyroid membrane, but at the first touch of the knife she sank bank, apparently dead. I immediately completed the operation, and introduced a large silver tube, through which the lungs were inflated; in the course of a few minutes, the action of the heart recommenced, and the patient eventually recovered. She has never, however, been able to breathe without the silver tube, which she wears in her windpipe up to the present time. In another case to which I was hastily summoned by my friend Mr. Tweed, I found the patient, a young woman, in the last stage of asphyxia from acute disease of the larynx. I immediately proceeded to operate, with the assistance of my then house-surgeon, now the Professor of Clinical Surgery at Edinburgh; Mr. Lister. As the patient's neck was short and thick, and the veins excessively turgid, there was profuse hæmorrhage on the first incisions being made; while we were waiting a minute or two until this would cease before opening the windpipe, the patient fell back and apparently expired. I lost no time in plunging the scalpel into the crico-thyroid membrane, and cutting down through the cricoid cartilage, so as to make a free aperture into the air-passage. On endeavouring to set up artificial respiration, I found the chest clogged with inspissated mucus, which prevented the entrance of air into the lungs; the life of a fellow-creature being at stake, and dependent on the immediate and full establishment of artificial respiration, I felt that there was only one thing to be done—to empty the chest of the matters loading it, and that this must be done instantaneously. I accordingly applied my lips to the wound, and sucked out three or four mouthfuls of blood and mucus, when I had the satisfaction to see that air could be made to enter the lungs. By keeping up artificial respiration for some time, the heart began feebly to act, the face to become less livid, and the circulation to be re-established; the patient eventually did well, and is now alive and in good health.

OPERATIONS.—In opening the windpipe, the Surgeon has the choice of two situations in which he may make the aperture; either in the crico-thyroid membrane by **Laryngotomy,** or in some part of the trachea by **Tracheotomy.** Besides these two established operations, some Surgeons have performed a third—**Laryngo-tracheotomy,** by opening the crico-thyroid membrane, and dividing the cricoid cartilage with the upper rings of the trachea.

Whichever operation is performed, so soon as the windpipe is opened, the patient is seized with an attack of spasm and convulsive cough, often attended by much struggling and distress, during which the whistling occasioned by the passing of the air through the new passage is very loud and marked. The patient, however, soon recovers himself, and then breathes naturally and easily, the signs of asphyxia disappearing.

The windpipe may require to be opened either by laryngotomy or tracheotomy for the following conditions (L = Laryngotomy : T = Tracheotomy) :—

1. Acute laryngitis with œdema of the glottis in the adult (L).
2. Chronic œdema of the glottis with suffocating spasms (L).
3. Syphilitic or other ulcerations of the glottis with chronic œdema (L).
4. Croup in children (T).
5. Diphtheria in children (T); in adults (L).
6. Necrosis of the cartilages of the larynx with obstructive thickening of tissues (T or L).
7. Epithelioma of the epiglottis (L).

8. Tumours in the larynx (L).

9. Scald of glottis by boiling water or acids (T or L, according to age of patient).

10. Foreign bodies impacted in the larynx (L).

11. Foreign body in the trachea or bronchus (T).

12. Impactions of foreign substances in the pharynx (T).

13. Asphyxia from any cause by which the glottis is mechanically closed (T or L, according to the age of the patient).

14. Accidents in operations about the head and face by which blood accumulates in the pharynx (L).

15. As a preliminary step in certain operations on the bones of the face, attended by much hæmorrhage (T).

16. Laryngeal spasm from compression of the inferior laryngeal nerve by aortic aneurism (L).

LARYNGOTOMY is an easy operation. The crico-thyroid membrane is almost subcutaneous, and may readily be reached by making a vertical incision in the mesial line, between the sterno-hyoid and sterno-thyroid muscles, about an inch in length, and then a cross cut through the membrane with an ordinary scalpel. The air-passage having thus been opened, a silver tube, curved on the flat, may be readily introduced and retained by tapes round the neck. The only troublesome result that can occur in this operation is the wound of a small artery, the crico-thyroid branch of the superior thyroid, which crosses the membrane. I have never seen any trouble arise from this; but, should it occur, the hæmorrhage would readily be arrested by the application of pressure or ligature.

TRACHEOTOMY consists in making an opening into some part of the trachea, by exposing the tube and cutting across two or three of its rings.

In performing tracheotomy, the patient's shoulder should be supported with pillows, and his head be thrown as much back as practicable. An incision about an inch and a half in length should then be made with a scalpel directly in the mesial line, from the cricoid cartilage downwards. After dividing the integuments, any veins that present themselves should be avoided as carefully as possible, being held aside with a blunt hook. By using the point of the scalpel to a limited extent, and dilating the deeper portions of the incision with its handle or with a director, the trachea may be reached with safety. It should then be transfixed and drawn forwards by a sharp hook, and opened by pushing the point of the knife, with its back turned towards the sternum, between two of the rings, and cutting upwards through about three of them (Fig. 647). The tube must then be introduced, and retained by tapes round the neck.

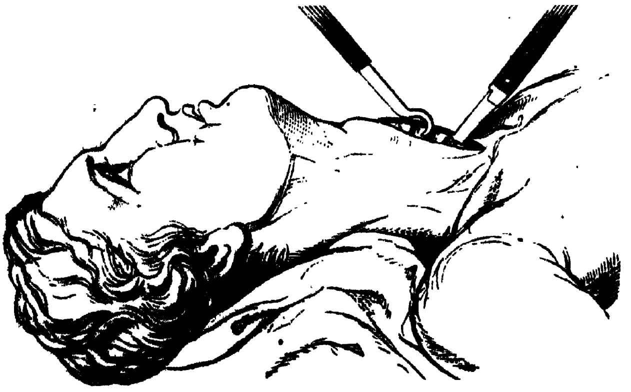

Fig. 647.—Operation of Tracheotomy.

The question as to the safety of the administration of chloroform in these operations often occurs. I believe that it may always be given safely except in cases of extreme syncopal asphyxia, where, as sensibility no longer exists, it is unnecessary. Laryngeal inflammation and obstruction are always associated with so much spasm, more particularly in children, that it will often be found that the patient respires more easily and fully whilst under the influence of chloroform than before its inhalation was commenced; and, as the anæsthesia materially facilitates the operation by doing away with his writhings and strugglings, I now invariably have recourse to it when I perform tracheotomy on children. In laryngotomy in the adult it does not appear to me to be necessary.

**Difficulties.**—This operation is often attended by extreme difficulty, and not unfrequently by much danger.

The difficulties occurring in tracheotomy are chiefly referable to four heads; 1. Difficulty in Exposing the Trachea; 2. Profuse Hæmorrhage; 3. Difficulty in Opening the Trachea; and 4. Trouble in Introducing the Trachea-tube.

1. The difficulty in **Exposing the Trachea** increases greatly as the incisions approach the sternum, and is especially great in children and in stout short-necked persons.

There are three situations in which the trachea may be opened; either above, underneath, or below the isthmus of the thyroid body, which usually crosses the air-tube opposite its third or fourth ring. Above the isthmus, the trachea is comparatively superficial, and is not covered by any venous plexus, nor does any other source of difficulty present itself to the Surgeon. Where the isthmus crosses the trachea, this tube is overlaid by a venous plexus as well as by the glandular structure. Below the thyroid gland, the air-tube is overlapped by the sterno-hyoid and sterno-thyroid muscles, and by the inferior thyroid veins, which are of large size, together with some tracheal branches from the inferior thyroid artery; and not unfrequently an irregular arterial branch ascends in this situation in front of the trachea to supply the thyroid body. The carotid arteries also are in close relation to the trachea on each side; and opposite the episternal notch it is crossed by the left carotid and by the innominata, which vessel has been seen by Macilwain to cross the tube at the very point where tracheotomy is usually performed. A glance at these important relations will suffice to indicate the difficulty that must, in many cases, occur in exposing and opening the trachea. This difficulty is greatly increased when the veins of the neck have become turgid in consequence of the pulmonic obstruction. It will also be seen that the trachea is less covered, and may consequently be much more readily reached above, than below, the isthmus of the thyroid gland. Though some Surgeons, as Velpeau, for instance, have recommended the opening to be made in the lower part of the tube, no advantage whatever is gained by so doing, whilst the difficulties of the operation are very seriously increased; and in practice it is almost invariably opened at its upper part, usually between the second and third or third and fourth rings, though the incision may, if necessary, be carried downwards as low as, or even through the isthmus.

2. The **Hæmorrhage** may occur either from arteries, from veins, or from the thyroid gland. Arterial hæmorrhage is less frequent and troublesome than

the bleeding from other sources. When it occurs, it chiefly happens from the wound of some anomalous branch, or from that of the small tracheal vessels. Desault has, however, mentioned a fatal case, in which death arose from a wound of the carotid. The arterial anastomosis of the isthmus of the thyroid body may, if this part be enlarged, occasion some difficulty in the performance of the operation; but the main source of danger unquestionably proceeds from the *venous bleeding.* Not only are the plexuses of veins of large size, more particularly where they cover the lower part of the trachea, but they become immensely gorged by the asphyxia that necessitates the operation. Hence, when they are wounded, the bleeding may be so abundant as scarcely to be controllable, and may very greatly retard the after-steps of the operation. Many Surgeons of authority in these matters advise that the windpipe should not be opened until all, or nearly all, the bleeding has ceased; lest the blood, entering the bronchi and lungs through the aperture, asphyxiate the patient. But in this way much valuable time may be consumed, and the patient may be fatally exhausted by a tedious and prolonged operation, and by the loss of an unnecessarily large quantity of blood. The hæmorrhage in this operation is almost entirely venous, and is, in a great measure, dependent on the distension of the veins of the neck, which occurs in asphyxia as the result of the accumulation of blood in the right cavities of the heart, consequent upon the obstructed circulation through the lungs; and the bleeding will continue so long as that obstruction remains unmoved. But as the respiratory process is re-established, this obstruction to the pulmonic circulation diminishes, the cardiac cavities become unloaded, the venous turgescence of the neck subsides, and the hæmorrhage proportionately lessens. This I have repeatedly found in asphyxia artificially induced in animals; and I have often seen it in the human subject, in cases in which it has become necessary to open the windpipe at once, without waiting to arrest hæmorrhage. Hence, except in those instances in which an arterial twig or large venous trunk has been wounded, and which must of course be secured, the occurrence of bleeding, though tolerably smart, need not deter the Surgeon from opening the windpipe; as the relief afforded to respiration will induce a corresponding and rapid diminution in the venous turgescence of the neck, and in the consequent flow of blood from the wound.

3. Another difficulty in tracheotomy sometimes attends the process of **Opening the Trachea** after it is exposed. In consequence of the convulsive breathing of the patient, the sterno-mastoids are put upon the stretch, thus increasing considerably the depth of the wound in the neck; and, at each short and gasping respiration, the air-tube is rapidly pumped or jerked to and fro, approaching to and receding from the surface in such a way that the scalpel cannot be thrust into it with safety. In order to do this with the least risk, a sharp-pointed hook should be passed between two of the rings, and the tube being thus fixed, opened by cutting upwards (Fig. 647). Or the hook, being

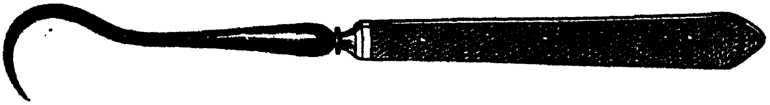

Fig. 648.—Trachea-hook-Director.

grooved along its convexity, as Edwards recommends (Fig. 648), is to be introduced under the cricoid cartilage, and the air-tube pulled up and opened by sliding the scalpel along the groove of this hook-director. I have found it advantageous in some cases to open the trachea with a cutting hook, such as is here represented (Fig. 649). By means of an instrument of this kind, the trachea is first fixed and then divided without danger to the patient.

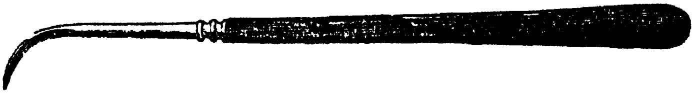
Fig. 649.—Cutting Trachea-hook.

The danger from hæmorrhage, and the difficulty in opening the trachea, are much greater in children than in adults. Before the age of puberty, this tube is deeply seated, covered with a quantity of loose granular fat, containing many veins, and is of small size, so that a slight deviation of the incision to one side or the other may readily lead the Surgeon astray, and into dangerous proximity with the carotid artery.

4. After the trachea has been opened, the next point is to **Introduce a proper Tube.** In doing this, special care must be taken not to push the tube into a sort of pouch which always exists at the lower angle of the wound, between the trachea and the deep fascia of the neck. This error is not only embarrassing in the highest degree to the Surgeon, but dangerous to the patient by the delay it occasions, by the compression exercised on the trachea below the opening into it, and by the suction of blood into the aperture in the air-tube. It is best avoided by expanding the tracheal opening with the dilator (Fig. 652), and passing the tube between the blades of that instrument. In the first instance, a tube of a conical shape should be employed, as it is not only introduced more readily than a cylindrical one, but fills up completely the aperture in the trachea, so as to prevent the draining of blood into the lungs. In passing the tube into the trachea some difficulty may be experienced, owing to the elasticity of the sides of the incision in the windpipe, in consequence of which one of

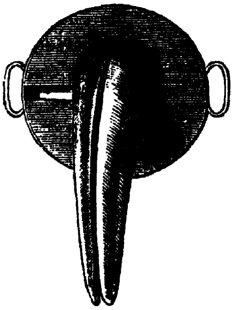
Fig. 650.—Bivalve Tube closed.

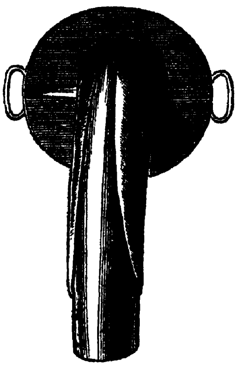
Fig. 651.—Bivalve Tube with Cannula introduced.

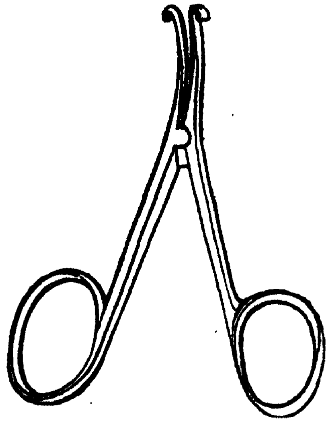
Fig. 652.—Trachea-dilator.

them is apt to be doubled in under the end of the instrument. This may be avoided by the use of Fuller's bivalve tube introduced closed (Fig. 650), and then expanded by slipping a cannula into it (Fig. 651); or one side of the cut in the trachea may be held aside with the forceps or a blunt hook, whilst the tube is slipped under the other. If the rings of the trachea be very rigid and unyielding, the silver tube may most conveniently be introduced by expanding the incision by means of the trachea-forceps (Fig. 652), and then passing it between or under their blades.

Some Surgeons prefer, instead of the scalpel, to open the trachea with cutting forceps, or with a trochar carrying a cannula in the shape of a trachea-tube, which is then left in the air-passage; these instruments, though ingenious and in some respects useful, do not appear to me to be so safe or easy of management, especially in children, as the scalpel and trachea-hook.

**Tracheotomy in Children** is never an easy, and is at times a dangerous operation. The difficulty of the operation arises more particularly in infants and very young children from the shortness of the neck, the depth and small size of the trachea, and the quantity of granular areolo-adipose tissue lying over it. The danger of the operation results from the large size of the venous plexus in connection with the thyroid body, and the proximity of the carotids. In performing this operation in young subjects, chloroform should always be administered. This may be done with safety, even though the most urgent asphyxia be present; the difficulty of respiration, being in a great measure spasmodic, is relieved by the anæsthetic. If chloroform be not given, the struggles of the child will seriously embarrass the operator, and add much to the danger of the operation. The incision must be very carefully placed on the mesial line; and after the fascia of the neck has been opened, the knife should be used as sparingly as possible, and the tissues rather pushed and held aside with a director. The trachea, when exposed, must be raised up by transfixion with the director-hook and carefully opened, the knife being neither thrust so deep as to wound the posterior part, nor turned laterally. As soon as the trachea is opened, the tube should be introduced; and this step of the operation is greatly facilitated by holding the trachea well up and drawing it forward with the hook. When the tube is fairly in, the hook must be withdrawn.

**Comparison of Tracheotomy and Laryngotomy.**—On comparing tracheotomy, as ordinarily performed, with laryngotomy, I think there can be little doubt that the Surgeon should give the preference, in all cases where it is practicable, to the latter operation, on account of its greater simplicity, safety, and rapidity. In all cases in which the obstruction to respiration is produced by inflammatory effusion into the submucous areolar tissue, whether dependent upon idiopathic or erysipelatous laryngitis, œdema glottidis, or chronic disease of the larynx, or upon the irritation and inflammation excited by swallowing boiling water or the stronger acids, the swelling, for reasons that have already been mentioned, never extends below the true vocal cords; hence an opening into the crico-thyroid membrane will always be below the seat of obstruction. An objection, it is true, has been urged to laryngotomy in these cases, that it does not allow the patient to wear a tube without much irritation being induced. This, however, I have not found to be the case in my practice. I have had patients who have worn silver tubes in this situation a considerable number of years, in one case as many as twelve, and in whom no special irritation has been occasioned by them. When the windpipe requires to be opened for the extraction of a foreign body, tracheotomy should be performed in preference to laryngotomy, as the latter operation does not admit of sufficient space for its expulsion or extraction. In children the larynx is so little developed, that tracheotomy becomes necessary.

In my opinion, laryngotomy is the operation that should, in cases such as above mentioned, be preferred in the adult; and this opinion is based on the following reasons.

1. As in laryngotomy the air-tube is always opened below the seat of obstruction, there can be no necessity to make an aperture farther from the seat of disease. In laryngitis, whether that affection assume the acute or the chronic character, the obstruction to breathing is in a great measure mechanical, and depends upon the infiltration of the submucous areolar tissue of the larynx, and partly of the large plane of this tissue, which lies behind the box of the larynx, and which, by expanding, as it were, into the pharynx, obstructs deglutition, and afterwards, by the extension of this swelling and infiltration to the lips of the glottis and the interior of the larynx, causes an impediment to the entrance of air into the bronchi. But, as has been pointed out by Prescott Hewett, this submucous areolar tissue terminates at the true vocal cords, where the mucous membrane becomes directly applied to the subjacent fibrous structures; the swelling and consequent mechanical impediment are hence confined to the limits of the thyroid cartilage, and any opening made below this will clear the lowest limit of the disease, which is always accurately and almost mathematically bounded below by the vocal cords. Hence an aperture in the crico-thyroid membrane is quite as effectual as one in the trachea.

2. Laryngotomy is a far safer operation than tracheotomy. On this point I need scarcely dwell; a glance at the anatomy of the parts concerned will be sufficient to establish it. The crico-thyroid membrane is nearly subcutaneous, and no parts of importance can be wounded in opening it, if we except the small crico-thyroid artery which crosses it, and which might be cut across, but from which I have never seen any trouble arise. The trachea, on the contrary, is not only deeply seated, but covered by a large plexus of blood-vessels, which, when rendered turgid by the asphyxiated condition that exists when an operation is required, pours out a large quantity of dark blood, and thus seriously embarrasses and delays the Surgeon at a time when the life of the patient depends on the speedy admission of air to his lungs.

3. Laryngotomy can be much more quickly performed than tracheotomy. This I look upon as an inestimable advantage in many of the cases requiring operation; a few seconds more or less being sufficient to turn the balance either in favour of life or of death. The rapidity with which laryngeal obstruction —partly mechanical and partly from spasm—sets in, is sometimes so great, more particularly when an acute inflammation supervenes on chronic disease of the larynx, that life may be extinguished before the Surgeon has time to open the windpipe, if he endeavour to do so by tracheotomy. In extreme cases, as where the lungs have become slowly engorged, the action of the heart is already enfeebled, and a sudden spasm occurring at the glottis, will at once place the patient beyond recovery. But even though life appear for the moment extinct,

it is the imperative duty of the Surgeon to open the air-passage as speedily as possible, and to endeavour, by means of artificial respiration, to recall the flickering spark ; and it is impossible to experience a greater satisfaction in the exercise of our profession, or to witness a greater triumph of art, than in thus snatching a patient out of the very jaws of death.

**Laryngotomy** should, therefore, be practised on the adult in impending asphyxia from the following causes :—1. Acute laryngitis ; 2. Erysipelatous laryngitis—œdema glottidis ; 3. Chronic ulceration and disease of the larynx ; 4. Scald of the pharynx, &c., from swallowing corrosive liquids ; 5. Spasm from pressure on the recurrent laryngeal nerve ; 6. Diphtheritic exudation.

**Tracheotomy** should, as a general rule, be preferred in children, and should be performed on them for obstruction to respiration from—1. Croupy exudation ; 2. Diphtheritic effusion ; 3. Swallowing boiling water ; 4. Foreign bodies in the air-passage of adult as well as child ; 5. Impaction of food, &c., in the pharynx.

**Trachea-tubes** should be of such a calibre throughout as to admit of respiration being carried on though them, without any effort on the part of the patient. Many of those that are to be met with in the instrument-makers' shops, though very wide at the mouth, are far too narrow and contracted at the lower aperture to allow a free and unimpeded passage for the air of respiration, being made very conical in order to admit of easy introduction, and to occlude completely the opening in the windpipe, so as to prevent the entry of any blood by the side of the tube. The disadvantage attending this mode of construction may in a great degree be remedied, by having a longitudinal opening like the large eye of a catheter cut in the side of the tube, immediately above the inferior aperture.

One great difficulty which the Surgeon has to meet in cases of tracheotomy or laryngotomy, is to keep the tube from being clogged and obstructed by mucus. It is usually stated that the tube may be kept clear by the occasional introduction of a feather, of a piece of sponge fixed to a stick, or a bit of lint wrapped round a probe. In this way it is true that the frothy or spumous mucus that collects in the tube may be readily enough cleared away ; but this simple means will in very many cases be found to be quite ineffectual in removing another kind of mucus that in certain conditions rapidly accumulates to a considerable extent within the tube. On examining a trachea-tube that has been worn for but a few hours, it will be found that its interior becomes gradually lined by a coating of dry, gummy, and very tenacious mucus, which is so firmly adherent to the metal as to render it necessary, before the tube can be properly cleaned, to detach this lining by means of a pen-knife or pointed probe ; or, what is better, by pouring boiling water through the tube. This tenacious mucus, collecting in largest quantity at the inferior aperture, and at the curve of the trachea-tube, may block up its calibre to a very great and dangerous extent, whilst the mouth of the tube appears to be perfectly pervious and free ; though feathers and pieces of stick armed with sponge or lint have been introduced from time to time, these, passing over this dry mucus, are quite unable to detach it from the side of the tube, and merely bring away the sputa and more frothy mucus.

Obré devised a very simple means to remedy this inconvenience. It consists in the trachea-tube being made of uniform calibre throughout, and having an interior tube accurately fitted to it, and projecting about one-eighth of an inch beyond the lower extremity of the outer tube. It is in the projection of the internal tube beyond the lower end of the external one that the great utility of this contrivance consists. If the two tubes be of the same length, or still more, if the innermost tube be the shorter, a plug of mucus may be left at the end of the outer cannula, on the withdrawal of the inner tube. But if this be the longer of the two, the end of the outer tube will be effectually cleared every time it is withdrawn, which may be done as often as any mucus collects, without in the slightest degree disturbing the patient. The two tubes are fixed by means of a button, attached to the edge of the outer one (Figs. 653, 654). The bivalve trachea-tube (Figs. 650, 651) is constructed on the same principle, the inner tube being longer than the outer; and it possesses the additional advantage of being readily removed for the purposes of cleaning, and as easily replaced. When used for laryngotomy, the tube may conveniently be curved on the flat (Fig. 655); the longest diameter being lateral instead of antero-posterior, thus being adapted to the form of the aperture in the crico-thyroid membrane.

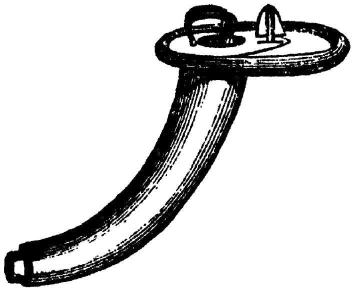

Fig. 653.—Trachea-tube, Side view.

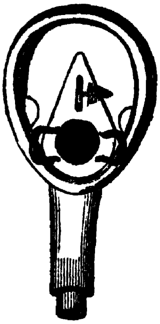

Fig. 654.—Trachea-tube, Front view.

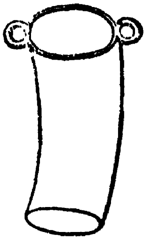

Fig. 655.—Laryngeal Tube.

It sometimes happens that, in consequence of the tube becoming detached from the shield, it slips into the trachea, where it acts as a foreign body. Cases of this kind have been related by Walters of Reigate, and by J. W. Ogle of St. George's Hospital. The removal of the tubes was effected by means of tracheotomy. For the prevention of such an accident, it has been suggested that the trachea-tube should be formed in one piece, instead of in two pieces soldered together.

When a trachea-tube has been worn for any length of time, it will almost always be found that ulceration has taken place in the trachea at some point as the result of pressure. The discharge from this ulcerating surface, and the increased secretion caused by the accompanying irritation, add greatly to the difficulty experienced in keeping the tube from becoming choked. To overcome these difficulties, Morrant Baker, of St. Bartholomew's Hospital, has employed a tube made of India-rubber, such as is used in the manufacture of the India-rubber catheter. It has sufficient rigidity to prevent its collapsing, but not sufficient to give rise to irritation or to cause ulceration. It is to be introduced after the first twenty-four hours, a silver tube being used till then. The tube is single, but the ease with which it can be removed and re-introduced is so great, that there is no difficulty in keeping it clean; in fact the irritation produced in so doing is said to be less than that caused by the removal of the inner tube of any ordinary double trachea-tube. Mr. Baker has found, from experience in a considerable number of cases, that it is worn with much greater comfort to the patient than a rigid tube.

**Trendelenburg's Operation.**—An ingenious and useful application and modification of tracheotomy has been devised by Trendelenburg and adopted by Langenbeck, in cases of operation about the jaws, palate, and pharynx, in which danger might arise from the inspiration of blood into the air-passage. The entrance of blood into the air-tube during these operations is dangerous, both directly, by the risk of suffocation; and also indirectly, by the blood finding its way into the air-cells, there coagulating, and thus disposing to bronchitis or pneumonia, a danger that is greatly increased by the inhalation of the breath loaded with septic influences from the suppurating and sloughy surfaces of the wound. With the view of obviating these dangers, Trendelenburg proposes the following operation. The patient having been placed under the influence of chloroform, tracheotomy is performed in the usual way above the thyroid body. A trachea-tube fitted with a hollow India-rubber collar (Fig. 656, 1) is then introduced, and the inhalation of the anæsthetic vapour carried on through it by attaching, by means of an India-rubber tube, a funnel containing a sponge (Fig. 656, 2). When the Surgeon is about to commence his operation, the collar is inflated by means of the India-rubber ball attached (Fig. 656, 3); the effect being to close the larynx above the tube, and thus to cut off all possibility of blood finding its way down the larynx into the bronchi and air-cells. After the operation is completed, the "trachea-tampon" is removed, and an ordinary trachea-tube is substituted and retained as long as it may be thought necessary.

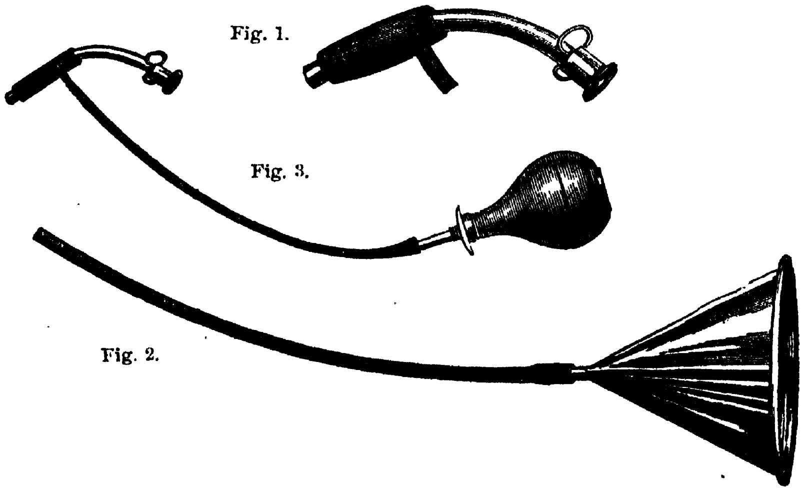

Fig. 656.—Trendelenburg's Trachea-Tampon.

1. The Trachea-tube and Collar slightly inflated. 2. The Inhaling Funnel.
3. The Inflating Bottle attached to the Collar on Trachea-tube.

## TAPPING THE CHEST

Tapping the Pleural Cavity.—The operation of **Tapping the Pleural Cavity** is required in cases of hydrothorax, empyema, and hæmothorax. The point of selection is a spot in the fifth intercostal space on the lateral median line. This point is crossed by a line drawn horizontally round the body from the nipple to the spine. The chest-wall is here thinner than elsewhere, and the trochar at once perforates the intercostal muscles.

The operation may be done by an ordinary trochar. But as it is of great importance in cases of hydrothorax to exclude the air from the pleural sac, it is usual to employ a trochar so constructed as to accomplish this end. The *Piston-trochar* (Fig. 657), or the one represented below (Fig. 658), may be employed. Whichever instrument is used, the operation should be done as follows. The skin having been punctured by a scalpel, the point of the trochar

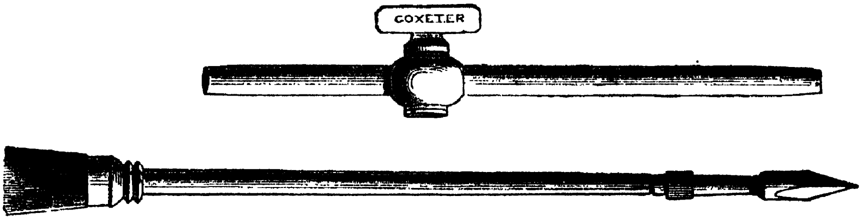

Fig. 657.—Piston-Trochar for Tapping the Chest.

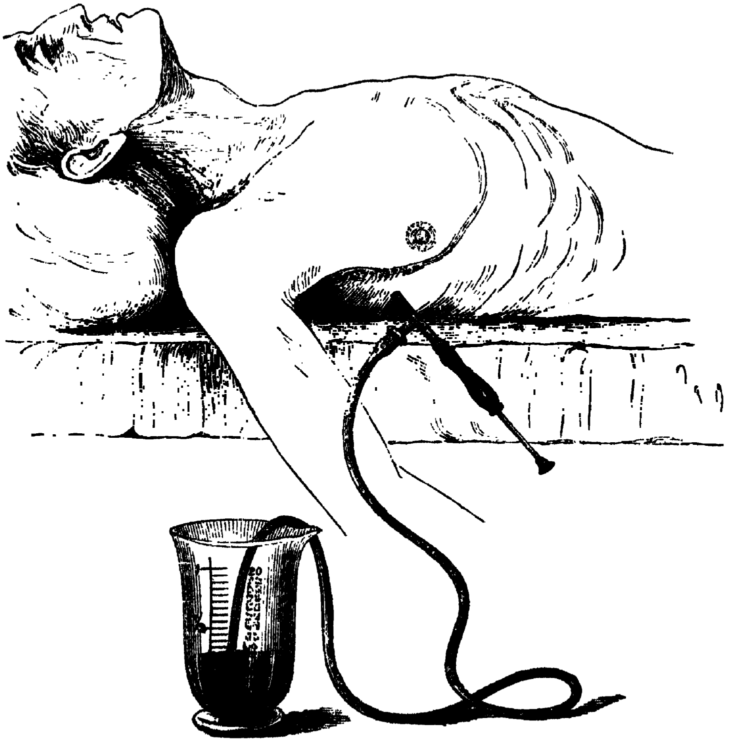

Fig. 658.—Tapping the Chest by the Suction-Trochar.

is slipped over the upper margin of the sixth rib into the middle of the fifth intercostal space, and thrust sharply and firmly into the pleural sac, so as to make sure of penetrating the thickened pleura and any layers of false membrane which, if the instrument were pushed slowly on, might be thrust before it (Fig. 658).

If the "piston-trochar" (Fig. 657) be used, the tap should be closed as the stylet is withdrawn, and an India-rubber tube attached to the end of the cannula. The tap being then opened, the fluid flows along this into a jar containing water. Or the *Suction-trochar* may be used (Fig. 658), the chest fluid being allowed to run off by the elastic tube, the end of which is immersed in water.

A third method of tapping the chest is by means of the *Aspirator* (Fig. 659). The air having been exhausted from the bottle and the stop-cock closed, the chest is tapped in the usual situation with the aspirator-trochar; and the cock on its side being turned on, the fluid rushes into the exhausted bottle to fill up the vacuum. The quantity drawn off is often very great, several pints from the adult; and even in children the amount of fluid may be immense.

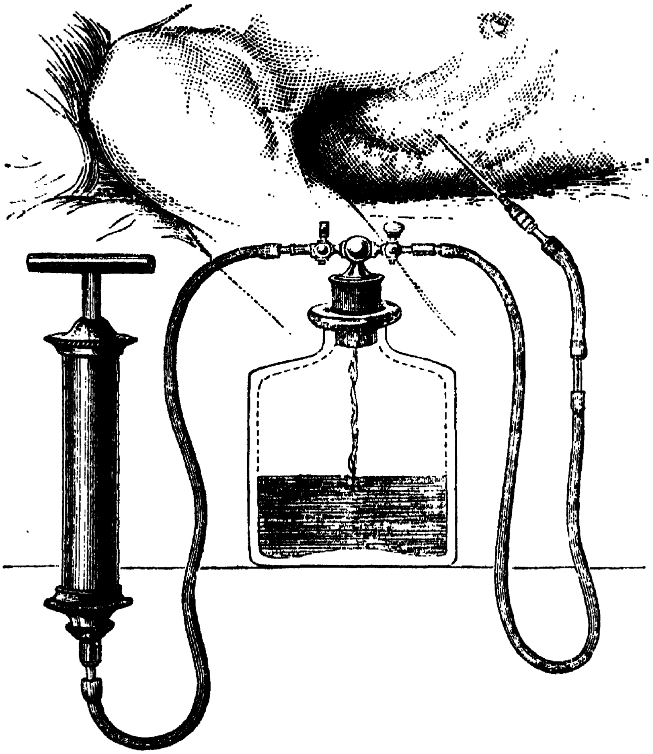

Fig. 659.—Tapping the Chest by the Aspirator.

The original aspirator, as invented by Dieulafoy, slightly modified, also answers the purpose very well. It has the advantage of being converted into a syphon, by which the force applied can be much more readily moderated. The forcible expansion of the lung, caused by connecting the pleura with so large a vacuum as is represented in Fig. 659, might sometimes be accompanied by danger, especially in cases in which the pleurisy is the result of injury, with perhaps wound, of the lung. The forcible expansion under these circumstances might give rise to hæmorrhage. One stop-cock C, as represented in the drawing (Fig. 660), closes both tubes. The piston A being withdrawn, and a vacuum so produced, the cock C is turned so that it is parallel to the syringe, and the vacuum is thus put in connection with the needle D. While doing this, the small cock at E must be closed. If it be determined to use the apparatus as a syphon, the cock E must be opened, and the handle of the piston forced down so as to fill a long tube passing downwards from E. The cock C now being turned off, the fluid will continue to flow. I have removed from 40 to 50 ounces from the chest of a child four years of age, and from the adult as much as 90 ounces. After the withdrawal of the cannula the puncture is closed by a pad of lint, strapping, and bandage, and will, if the fluid have been serous, usually readily unite. After tapping, the lung will either expand and fill up the cavity previously occupied by the fluid ; or, if adhesions prevent this, the thoracic parietes will gradually collapse.

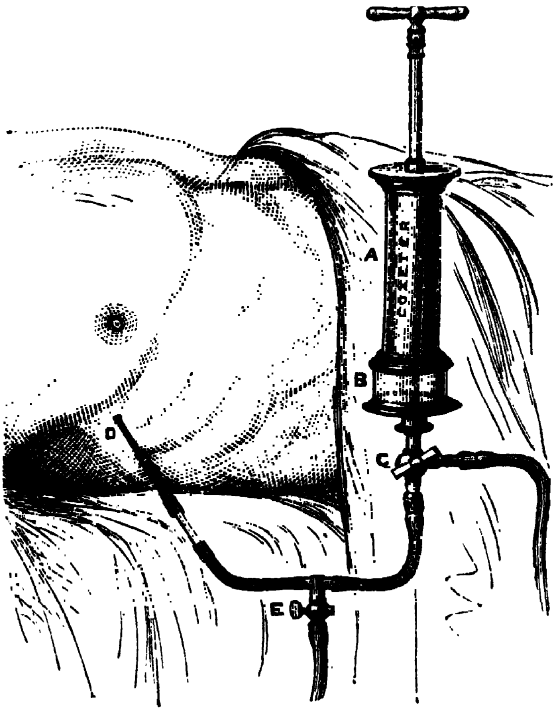

Fig. 660.—Aspirator convertible into a Syphon.

A. Brass syringe. B. Glass at lower end. C. Stop cock, putting the syringe into connection either with the discharge pipe or the needle. D. Needle. E. Small cock, opening into a side tube, to be used as a syphon if required.

If the accumulation be an *empyema*, a free incision should be made into the pleural sac, or a large trochar used, and the cannula or an elastic tube may be left in the chest, and the pus drawn off, or removed as it re-accumulates ; or a gum catheter or drainage-tube may be left in, and the pus allowed to drain off as fast as secreted. Should air have got admission into the empyematous pleura, it will be necessary to make the opening free, so as to secure a ready exit for the fluid, lest putrefactive changes ensue in it. In *hydrothorax*, however, it is of great consequence to prevent the entrance of air; and here every precaution to this end should be taken.

**Drainage-Tubes.**—Goodfellow and De Morgan have advantageously adopted the use of Chassaignac's drainage-tubes in the treatment of empyema, with the view of preventing the accumulation of pus, its fetid decomposition, and consequent irritative fever, and of allowing the gradual expansion of the previously compressed lung, or collapse of the chest-wall.

The mode of introducing the drainage-tubes into the pleural sac, adopted by De Morgan, is the following. A puncture with a trochar having been made in the usual situation between the fifth and sixth ribs, a long iron probe, slightly bent, is passed through this opening, and pushed downwards and backwards. It is then made to press against the thoracic wall at its lower and posterior part; and, being felt through the intercostal space, it is cut down upon, and its end exposed. A silk thread carrying the drainage-tube is now passed through the eye of the probe; and as this is drawn out at the lower opening, the thread and tube necessarily follow. The ends of the tube projecting from the opposite openings are then tied together, leaving the body of the tube in the pleural sac. The pus drops out as it forms; and thus the chest is kept empty by drainage through the tube and the lower counter-opening.

TAPPING THE PERICARDIUM.—In hydrops pericardii, attended with imminent danger of immediate death, it may be necessary to **tap the pericardium.** This may most safely be done by making an incision about half an inch in length through the skin and areolar tissue in the fifth intercostal space, in the cardiac region, and then slowly and carefully introducing a fine trochar at that point where percussion and auscultation have indicated the greatest amount of fluid. The trochar should be passed obliquely; and, as soon as it appears to have entered the pericardium, the stylet should be sheathed and the cannula pushed forwards until the serum escapes.

The operation is, however, much more safely done with the aspirator. From experiments made on the dead body, Dieulafoy concludes that the operation may be performed in the fourth or fifth interspace, the fifth being perhaps preferable, as it is nearer the apex of the heart and corresponds with a more dependent situation of the fluid. The puncture may be made from 2 to $2\frac{1}{3}$ inches from the left margin of the sternum. The spot having been selected should be marked with ink. If the patient be anasarcous, the interspace must be determined by carefully pressing away the œdema. The needle to be employed should vary with the case. If the diagnosis be certain, No. 2 (one millimetre, or roughly $\frac{1}{25}$ inch in diameter), should be used; but if the diagnosis be uncertain, No. 1, half this size, should be chosen, as with this needle, it is said, the heart may be punctured with impunity. The best form of aspirator to use is one such as is represented in Fig. 660, as needles of such small size are apt to be plugged with small flakes of lymph, and if such an accident occur, they may be cleared again by reversing the syringe and forcing a small quantity of fluid back into the pericardium. Before using the aspirator, it should be carefully tested with some carbolised water to see that the needle is pervious, and the whole apparatus in working order. A vacuum having been created in the aspirator by drawing back and fixing the piston, the needle is to be inserted at the spot determined on. As soon as the opening at the point of the needle is covered, the stop-cock leading to it is to be opened, so that the vacuum extends into the needle ; and "we now advance, vacuum in hand, in search of the effusion." The needle must be pushed slowly and carefully onwards in a direction upwards and inwards till the fluid appears in the glass tube of the aspirator. The moment this occurs all movement of the needle must cease, and it must be held steadily as long as the fluid continues to flow. Any unnecessary movement may scratch and injure the surface of the heart. If the flow cease suddenly as if from some obstruction, a little fluid may be forced back as above stated to clear the needle. After withdrawing the needle no dressing is required to the minute puncture. Over a pint of fluid has been removed by this means at one operation. In inserting the needle, care must be taken not to force it through a costal cartilage, or a small plug of cartilage may be cut out which would effectually close its canal.

# CHAPTER LXI.

## DISEASES OF THE BREAST.

By **Disease of the Breast** is meant an affection of the mammary region, not merely of the mammary gland. These diseases may occur in the male as well as in the female. They are necessarily most frequent as well as most important in the latter, the rudimentary mammary gland of the male being little predisposed to such affections in comparison to the highly developed and active organ in the female.

Diseases of the breast, when they occur in the female, are of much interest to the Surgeon; not only on account of their great variety, but from the difficulties attending their diagnosis, and from the importance attaching to the question of operative interference in connection with them.

Diseases of the breast seldom occur before puberty, being most frequently met with either during lactation, when the functions of the gland are in a high degree of development; or towards the termination of menstrual life, when the actions of the organ are necessarily influenced by the changes that are taking place in the uterine system. But there is this important difference between the diseases at these different periods of life, viz., that in the young they are of a simple, in the older woman frequently, if not generally, of a malignant nature. Just before or at puberty, the breast occasionally becomes the seat of inflammation and abscess; in all probability owing to changes taking place in it in connection with the general development of the reproductive system. As the period of puberty approaches, the breasts often swell, become hard, knotty, and somewhat painful, indicative of some commencing change in the generative system. In other cases again, a precocious hypertrophy may take place, frequently attended with severe neuralgia in the part. When puberty occurs, the breasts naturally enlarge, and often become tender; and occasionally one undergoes a certain degree of hypertrophy, increasing greatly in bulk beyond the other. These various changes, though exciting alarm in females, cannot be regarded as of any very serious importance, and seldom require more than the simplest surgical treatment.

### ANOMALIES OF DEVELOPMENT.

The mammary gland is subject to certain anomalies as to development. Thus, in some instances it has been found to be *altogether wanting.* Sir A. Cooper and Froriep both relate instances in which the organ was not developed, and in which the ovaries were also deficient. A more remarkable anomaly consists in the development of a number of **Supernumerary Breasts.** Birkett has collected fourteen reported cases, in which there were more than two breasts; most frequently there is but one supernumerary gland, sometimes two; and occasionally, though very rarely, three have been met with, constituting quintuple mammæ. **Supernumerary Nipples** have likewise been found to occur; two to each breast have been met with, each communicating with the gland, and passing milk. Most frequently the supernumerary breast is situated somewhere in the neighbourhood of the normal gland, as on the anterior part of the thorax; and where four are developed, they have been found placed in two parallel rows, one above the other. Occasionally they have been met with in very strange situations; thus they have been seen on the outer part of the thigh, in the groin, and on the back; and children are even said to have been suckled by these abnormal breasts.

## NEURALGIA.

**Neuralgia of the Breast** occasionally occurs to so severe a degree as to constitute a positive disease, either in girls or at a more advanced period of life, when it not unfrequently complicates other more serious affections of this organ. It is especially apt to occur in young, delicate, unmarrried females of the hysterical temperament, though it is often met with in strong ruddy-looking women, who are perhaps subject to neuralgic pains in the back, and in other situations. Most commonly the catamenia will be found to be irregular; and uterine congestion, inflammation, or ulceration, will be discovered on examination; indeed, I have scarcely ever failed to detect one or other of these conditions in the uterus in cases of neuralgic breast.

*Symptoms.*—In neuralgia of the breast, the mammary gland may be of its normal size and consistence; but in some instances the whole of it is more or less indurated and hypertrophied. There are always much general pain and aching, deeply in its substance, with cutaneous tenderness of its surface, and lancinating or radiating sensations that extend into the axilla and down the arm. These painful sensations are commonly increased before the menstrual period, and not unfrequently alternate in the two breasts.

*Diagnosis.*—The diagnosis of this affection from more serious mammary disease may usually be effected by attending to the superficial and radiating character of the pain, to the temperament of the woman in whom it occurs, to its shifting seat, and to the absence of any positive signs of disease in the breast.

*Treatment.*—The treatment consists especially in attention to the condition of the uterine organs; unless this be done in a proper way, the disease will prove to be excessively rebellious and troublesome to manage. By using the speculum, however, when necessary, and removing by proper remedies any uterine irritation that may be found, this affection will be subdued with far greater readiness than by any local plan of treatment. At the same time, antihysterical constitutional remedies may be employed; the preparations of iron administered, when necessary; and the local pain relieved by the application of belladonna and opiate plasters, or by hypodermic injections of morphia.

## HYPERTROPHY.

Simple Hypertrophy of the Breast is not unfrequently associated with very severe neuralgia of the organ. An increase of size, such as naturally takes place during pregnancy, between the fourth and ninth months, will occasionally commence at puberty, and go on until the organ attains an enormous bulk, as in Fig. 661, which represents the breast of a very thin girl of fifteen, who was under my care for this condition. In some cases the breast has been found after death to weigh as much as twenty pounds; and after removal, a breast of this kind, taken from a young woman under thirty, has weighed no less than twelve pounds, being entirely composed of its normal tissues, greatly hypertrophied. In these cases of hypertrophy both breasts are usually affected, though one is commonly more so than the other. When first this morbid condition commences, the breast preserves its usual shape, though it is increased in bulk; but as it enlarges it gradually projects forwards, drawing down the skin of the shoulders, of the side of the chest, end even of the back, and hanging downwards, until, as in a case mentioned by Bérard, it has been known to reach to the knees.

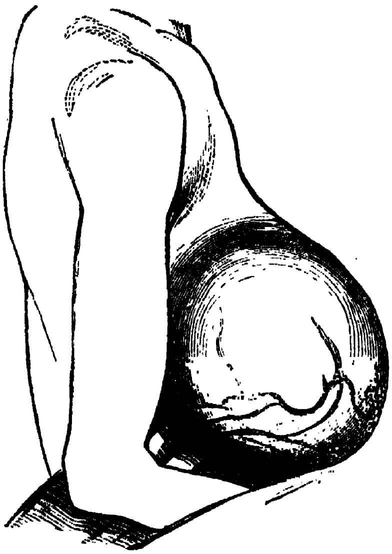
Fig. 661.—Simple Hypertrophy of Breast in a Girl fifteen years old.

*Treatment.*—The treatment of this affection is very unsatisfactory. The general health must be attended to, and an endeavour may be made to excite lactation, and thus to unload the vessels of the breast by the employment of galactagogue remedies. Amputation of the organ should not be performed in these cases, unless the growth attain so great a size as to render life a burden. Then the mass may be extirpated with little trouble or danger.

Lobular Hypertrophy of the Breast has been described by Sir A. Cooper as occurring chiefly in unmarried women between thirty and forty years of age. It appears on manipulation to be composed of several solid but movable masses, which after a time begin to diminish in size, until the breast at last atrophies, and is in a great measure absorbed. It would appear to be rather a species of the chronic mammary tumour than a pure hypertrophy.

## ABNORMAL CONDITIONS OF THE LACTEAL SECRETION.

The lacteal secretion is occasionally the cause of abnormal conditions in the breast. Thus the milk may appear *at unusual times*, a twelvemonth, for instance, after weaning; it has occasionally been known to be secreted in children, and in some remarkable instances in boys and men. In other instances again, after parturition, there is a total **Absence of Milk**, either owing to want of development in the gland, or to debility on the part of the mother. The opposite condition will occasionally occur, and an **Excessive Flow of Milk** may continue, especially in hysterical females long after the child has been weaned. In such cases as these, the *galactorrhœa* may be checked by the application of the extract of belladonna to the breast, aided by the employment of tonics, and the administration of acids.

LACTEAL TUMOUR.—It may happen during lactation that one of the lactiferous ducts becomes obstructed, either by its being obliterated by inflammation or occluded by the deposit in it of a small concretion—a lacteal calculus. In either case the walls of the duct may be expanded, so that at last it constitutes a moderate-sized cyst, fluctuating on pressure, and evidently containing fluid. In some cases, the lacteal tumour has been known to attain an enormous size. Walpy has related a case in which he drew off ten pounds of milk by tapping a collection of this kind. These tumours may exist for a considerable time. Dupuytren records an instance in which one had existed for ten months, and Cooper one of a year's duration. In these chronic cases the milk usually undergoes changes, becoming creamy, thick, and oily ; and in some instances it would appear to leave a solid residue by the absorption of its watery parts. In other instances the milk appears as if diffused through the substance of the gland and its ducts, constituting a spongy semi-fluctuating tumour. Velpeau has pointed out that these lacteal deposits undergo a series of changes, somewhat similar to those that take place in blood that has been extravasated ; becoming absorbed in whole or part in some instances, in others remaining fluid, and occasionally becoming encysted.

*Treatment.*—In these cases, the readiest mode of getting rid of the tumour is, as Sir A. Cooper advises, to make an oblique puncture from the nipple towards it, by means of a trochar and cannula, so that a fistulous track may be left, along which the milk is discharged, and thus got rid of ; the child being at the same time weaned, so that the secretion may cease.

In some cases after weaning, the milk may be diffused into the substance of the gland, or collected into masses of curd, forming hard nodules, which give a good deal of trouble, and may eventually lead to some of the forms of inflammation that will immediately be described ; these swellings are usually best removed by frictions with somewhat stimulating embrocations, such as camphorated oil, by which their absorption is promoted.

## INFLAMMATION OF THE BREAST.

**Inflammation of the Breast** may take place at any period of life. In childhood it occurs as the result of accidental causes, just before or at puberty, in boys as well as in girls, as a consequence of the general development of the organs of reproduction. But far more frequently it is the direct result of the exalted action taking place in the gland during lactation, which, in feeble and anæmic women, runs beyond the bounds of a normal standard. It is commonly met with during the first month or two after the birth of the child, and seldom occurs during weaning, but may, as Nunn has shown, be the consequence of unduly prolonged suckling, and thus appear at a late period—the tenth or eleventh month. It is most frequently met with in weakly anæmic women. The inflammation may affect any one of the constituents of which the breast is composed, and may be limited to this ; thus it may take place in the nipple ;

in the subcutaneous areolar tissue lying between the skin and the gland; in the gland itself; or in that extensive plane of areolar membrane upon which the gland rests, and which intervenes between it and the pectoral muscle. But, although the inflammation commonly affects these different parts, in many cases the whole of the breast appears to be affected, and no distinct implication of any special tissue can be made out.

**Inflammation of the Nipple and Areola.**—When the nipple and areola are inflamed, these parts become conical, red, and swollen, with much pain, owing to the density of the subcutaneous tissue in this situation. This affection, "the cracked nipple" of nurses, usually occurs at an early period of lactation in delicate women, and especially with the first child. It commences in the follicles of the part, being accompanied by superficial ulceration, abrasion, fissure, and cracks, with oozing of a small quantity of thin sero-puriform fluid, great pain during suckling—so great, indeed, as to prevent the proper continuance of this act; and usually attended by a good deal of constitutional irritation. In some instances, the fissured state of the nipple would appear to precede the setting in of inflammation; in other cases, the inflammation is the primary condition.

The *Treatment* is as follows. The child must be taken from the affected breast, both for its own sake and the mother's, the milk being drawn off by means of a breast-pump or sucker. The general health must be attended to; tonics given; the infant's mouth examined for aphthæ, which, whether as cause or as effect, are common, and must be treated on ordinary medical principles. If the nipple be not fissured, it should be covered with flexible collodion, or painted with an astringent; a solution of nitrate of silver, catechu, or tannin is the best. If it be fissured, a pointed stick of nitrate of silver must be applied to the bottom of the crack daily, or it may, if deep, be divided by drawing a lancet along it.

**Abscess of the Areola** not unfrequently occurs in suckling women, with the ordinary signs of local inflammation, terminating in circumscribed suppuration. The *Treatment* consists in the application of warm belladonna or lead lotion, and lancing the part early. In doing this, care should be taken that the cut be made from the centre of the nipple towards the circumference of the areola, so as not to divide the lacteal ducts.

INFLAMMATION OF THE BREAST, which, as it generally occurs in nursing mothers, and terminates in suppuration, is usually called **Milk Abscess,** may occur in three situations; 1, in the Subcutaneous Areolar Tissue, **Supramammary Abscess;** 2, in the bed of Areolar Tissue in which the Mammary Gland is lodged, **Submammary Abscess;** and 3, in the Gland itself, **Mammary Abscess.**

1. **Inflammation, followed by Abscess of the Subcutaneous Areolar Tissue of the Breast,** though common during lactation, occurs more frequently than any other form of inflammation in this region at other periods of life, more particularly about the age of puberty. Its symptoms are those of simple phlegmonous inflammation, differing in no way from abscess of this kind in other situations, except that it is always distinctly circumscribed.

2. **Inflammation in the Areolar Plane between the Mamma and**

**the Pectoral Muscle** diffuses itself over the whole of the areolar layer, and almost invariably runs into abscess with considerable rapidity, giving rise to great pain, of a deep, heavy, and throbbing character, much increased by moving the arm and shoulder, and attended by swelling, œdema, and a slight red blush upon the skin. The breast becomes prominent, is conical and projecting, the whole organ being pushed forwards by the pressure from behind; it is not readily movable on the pectoral muscles, the subcutaneous veins become engorged, and at last abscess forms. It is not always easy in these cases to determine whether suppuration has taken place or not, the depth at which matter forms rendering it impossible in the early stages to detect fluctuation until it approaches the surface; its presence may, however, be suspected on the occurrence of deep-seated throbbing pain, œdema, and some superficial redness. The abscess at last points at some part of the margin of the gland, usually at its lower and outer side, where the matter seems to gravitate; after a time, however, it will commonly appear at other points of the circumference of the gland, beyond which it always extends, seldom, if ever, perforating the structure. A series of four or five apertures, forming a large circle round the margin of the gland may thus form. It very commonly happens that the apertures through which the pus discharges itself in these situations, degenerate into fistulous canals, by no means easily closed.

3. **Inflammation of the Mammary Gland** itself is not of such frequent occurrence as either of the other forms of abscess. When the whole of the organ is affected, it gives rise to great swelling of the breast, with severe aching and lancinating pain, and much constitutional disturbance, usually of an irritative type. Not unfrequently one lobule only of the gland becomes inflamed; and then the local signs are proportionately limited, and occasionally cease. As Velpeau has pointed out, one lobule after another may become inflamed, so that a succession of abscesses forms in different parts of the gland. As the inflammation advances to suppuration, the skin is reddened, assumes a dusky hue, becomes glazed, has a peculiar greasy appearance, and pits on pressure. When matter has formed, the tension of the superficial parts, with œdema and perhaps deep-seated fluctuation, determine its presence.

*Treatment.*—In the treatment of inflammation and abscess of the breast occurring during lactation, it must be borne in mind that we have not a sthenic inflammatory condition to deal with, but that the disease almost invariably happens in delicate anæmic women, commonly of a strumous habit, and weakened by recent parturition; indeed, the affection appears to be an inflammation of an irritative and congestive rather than of a sthenic character. It is therefore obvious that antiphlogistic means of an active nature are not admissible; and the best plan of treatment appears to consist in keeping up the strength of the patient by proper constitutional support, at the same time that the local inflammation is checked by topical antiphlogistic measures. The first thing to be done is to prevent if possible the occurrence of suppuration; if this can be accomplished, which is, however, rarely the case, much will be gained. In order to effect this, the breast should be supported in a sling, so as to lessen congestion of it; the arm at the same time being fixed to the side, in order to prevent traction of the pectorals and movement of the submammary areolar tissue. If the patient's strength be good, leeches may be applied; in the majority of cases, however, they will not be required, but warm lead lotions or the assiduous application of camomile or poppy fomentations may be substituted in their stead; at the same time, the milk should be drawn off by means of a breast-pump or sucker, the child being put to the unaffected breast or weaned, and an occasional saline purgative administered. When suppuration is impending, the application of fomentations may be continued, the patient being allowed a more liberal supply of nourishment, with a moderate supply of malt liquor; and, so soon as matter can be felt, it should be cut down upon and let out by an aperture in the most dependent position. It is of great importance that the matter should be let out early, and by an opening into the lowest part of the abscess; if it be not, it burrows deeply, diffusing itself through the areolar tissue under, beyond, and around the gland, and opening at several points, leaves long fistulous tracks perforating the breast in various directions. When suppuration is going on, the patient's strength must be supported with tonics, the mineral acids, bark, and quinine. Porter must be liberally allowed, and plenty of nourishment given. The sinuses that are left may usually be induced to close by attention to the state of the general health: should they not do so, however, the employment of pressure and the use of stimulating injections may, in time, accomplish this. In the event of their proving rebellious, it has been proposed to slit them up; but this is an unnecessarily severe practice, and may, I believe, in all cases be dispensed with.

CHRONIC ABSCESS OF THE BREAST may assume two forms: the *Diffused*, and the *Circumscribed* or *Encysted*.

**Chronic Diffused Abscess** of the breast may occur at all ages, in the single or in the married. It usually appears in the submammary areolar tissue, often without any external exciting cause, but as a consequence of impaired health, in strumous or cachectic females, and is often connected with uterine derangement. It may acquire a very large size, and, pushing the mammary gland before it, gives the breast a conical pointed shape. Fluctuation soon becomes apparent, and the ordinary local signs of chronic cold or congestive abscess disclose themselves.

The *Treatment* of chronic diffused abscess of the breast consists in making a free outlet for the pus in a dependent situation, and keeping it free with a drainage-tube; at the same time that the general health is improved with iron or cod-liver oil on ordinary medical principles.

**Chronic Encysted Abscess** of the breast is a disease of great importance, inasmuch as it closely simulates various tumours in this situation; so much so, indeed, that it is only with extreme difficulty that the diagnosis is effected in some cases. The breast has in numerous instances been amputated on the supposition of its being the seat of tumour, when it was merely the seat of a very chronic thick-walled abscess. It usually commences as the result of pregnancy, whether complete parturition or miscarriage take place; sometimes as a consequence of lacteal inflammation, but usually without any injury or other direct local cause. An indurated indolent swelling forms, and this may gradually soften in the centre; but fluctuation may for a long time be very indistinct, and even absent, being obscured by the thick wall of plastic matter that is thrown out around the collection of pus. It is owing to the deposition of this dense mass of limiting fibrine, that the chronic encysted abscess is commonly developed as a hard and apparently solid lump. It is in general not very distinctly circumscribed, and of but moderate magnitude; after a time it remains stationary, or but slowly increases with but little pain during a space of many months; it is not unfrequently attended with retraction of the nipple.

*Diagnosis.*—The diagnosis of this form of abscess is of great importance, inasmuch as it has not unfrequently been excised for *tumour* of the breast. I am acquainted with many instances in which this mistake has been committed. Such an error may, however, commonly be avoided by attention to the following points: 1, that the existence of an abscess is almost invariably preceded by impregnation, parturition, or miscarriage; 2, that there is more or less œdema of the subcutaneous areolar tissue covering it; 3, that, although it is of slow formation and without pain, it is not distinctly circumscribed, but gradually fuses in an irregular manner into the neighbouring tissues; 4, that it is not freely movable, but rather incorporated with adjacent parts; and 5, that elasticity, or even deep fluctuation, may be commonly felt at one part of it. Should there be the least doubt in the case, the introduction of an exploring trochar, by giving issue to the pus, will always determine its true nature; indeed, this simple means of diagnosis should never be neglected in any case in which there is reason even to suspect the possibility of the apparent tumour of the breast being in reality an abscess.

*Treatment.*—In the chronic encysted abscess, as well as in the diffused form of the disease, the drainage-tube is most useful; but, should the mass of plastic matter be very large and dense, a seton may advantageously be passed across it in a perpendicular direction, so that the plastic tumour may be softened and caused to disappear by the inflammation thus excited in it.

In all cases of chronic abscess of the breast, but more particularly in the submammary, the arm should be kept at perfect rest in a sling or bandaged to the side.

## TUMOURS OF THE BREAST.

The study of the various tumours of the female breast, more especially in a diagnostic point of view, is of the first importance to the practical Surgeon; for, though it might be supposed that it would be easy, if not to recognise the minuter shades of pathological difference between morbid growths so superficially situated as those of the mammary gland, at all events to diagnose the malignant from the non-malignant affections of this organ, yet in practice nothing is more difficult in many cases: and it not only requires great experience, but also an intimate acquaintance with the special course and symptoms of each particular disease, to come to a correct conclusion as to its nature. Even with all the light which experience and a careful examination of the characters of the tumour may throw upon the nature of the disease, it will be impossible for the Surgeon to avoid occasional errors in diagnosis.

Mammary tumours may be either simple or malignant. The original recognition and classification of the different varieties of simple tumour that affect the breast-gland, is principally due to Sir A. Cooper; and this important department of surgical pathology has of late years been much extended by the researches of Velpeau, Birkett, and Paget. It is only very recently, however, that the confusion that has hitherto surrounded this very intricate subject has been cleared up, and it is chiefly by the recognition of the characters and by the study of the natural history of the various forms of sarcoma that affect the breast, that this has been accomplished.

### NON-MALIGNANT TUMOURS.

The non-malignant tumours of the breast comprise the *Chronic Mammary Tumour*, the different varieties of sarcoma and *Cystic Growth*, the *Painful Tubercle*, *Hydatid Cysts*, and various forms of *Fibrous*, *Cartilaginous*, and *Osseous Growths*.

**Chronic Mammary or Adenoid Tumour,** or **Adenoma,** is perhaps the most common variety of these benign structures. It usually occurs as the result of blows, squeezes, or lacteal irritation, and is almost invariably met with in young women under thirty years of age; usually in women otherwise healthy; and most frequently in those of a sanguineo-nervous temperament. It is often associated with the hysterical temperament, and connected with, if not dependent on, uterine irritation and sexual excitement of an irregular kind. This tumour is generally of small size when first perceived, and may remain stationary for many years; or it may slowly increase, and at last attain a considerable bulk. In other cases it may very rapidly grow to a great size. In a case on which I operated some years ago, the tumour had continued for eighteen years about the size of a walnut, but in the course of six months it increased to an enormous magnitude, and on removal weighed nearly five pounds.

This tumour usually commences as a small, movable, finely nodulated growth, attached by a pedicle to one side of the mammary gland; it is hard and incompressible, often appears isolated, and is not generally painful; it increases slowly, without discolouring the skin or becoming attached to it, and is frequently many years in attaining a moderate size. It is often floating, as it were, in the substance of the gland, into which it can be pushed back. This tumour is frequently mistaken for a cancerous growth, and the diagnosis is often as difficult as it is important; though in many cases the otherwise good health of the patient, the mobility of the mass, the absence of all implication of the skin or glands, the want of hardness, and its circumscribed character, will indicate its true nature.

On examination after removal, an adenoma appears to be irregularly lobulated, is encapsuled, and its cut surface is found to present a bluish or greyish-white colour, which, after exposure to the air, assumes a rosy tint; and, on pressure, drops of a thick creamy fluid are often seen to exude. Under the microscope, it has been found by Birkett to consist of imperfectly developed hypertrophy of the glandular tissue; the terminal cells of which are filled with epithelial scales. For microscopical characters, see Figs. 290, 291, p. 764, Vol. I.

Adenoma, though usually very chronic in its progress, may at times assume extreme rapidity of growth, so as almost to simulate malignant disease. This usually happens in those cases in which an adenoma has remained in a quiescent state from an early period up to about the middle of life, or in which it developes for the first time between the ages of 35 and 40 years. In these instances it will grow with extreme rapidity, attaining in a few months a size equal to that of a cocoa-nut, or even larger, and simulating in this respect the progress of an encephaloid tumour. Such rapidly growing adenomata are painless, and, however large, continue perfectly movable, free from deep adhesion, or from glandular implication; the skin covering them is healthy, thinned, and unadherent, the nipple projecting usually very prominently. The tumour itself will be felt to be nodulated, semi-elastic, not stony, and always rounded in outline. After removal its section is lobulated and glistening, something resembling a mass of rice or sago jelly, often having cysts interspersed through its substance, containing fluid or semi-solid glandular tissue.

*Treatment.*—This consists in attention to the general health, and in the employment of local absorbent remedies. Under this treatment, adenomata have occasionally disappeared; in some instances they have been known to become spontaneously absorbed after marriage or during pregnancy. If obstinate, their dispersion may be facilitated by the occasional application of two or three leeches, followed by inunction of iodide of lead ointment; and by the internal administration of Plummer's pill, and the compound decoction of aloes. In addition to these means, the employment of compression will be found especially serviceable; this may be applied either by means of Arnott's slack air-cushion, or by Tanchou's plan, which consists of a pad to which a spiral spring is attached, and which, being compressed by a proper arrangement of bandages across the chest, will keep up steady and continued pressure upon the tumour. I have employed this kind of apparatus, which is far less expensive and cumbersome than the air-compressor, in several cases of adenoma, with great benefit. The advantage attending it is, that it can be used in conjunction with absorbent ointments, which cannot be used with the air-bag, as the grease entering into their composition destroys the macintosh cloth of which it is made. In this way absorption may not unfrequently be secured; and I am disposed to think that not a few of the so-called cases of cancer of the breast that have been reported as having been cured by pressure, were in reality instances of the adenoma in which absorption had been brought about in this way. Should the growth attain too great a magnitude to admit of absorption by the means that have just been recommended, its excision must be practised. In doing this it is not necessary to remove the whole of the breast, but it will be quite sufficient to extirpate the tumour itself, and at most the small lobe of mammary gland connected with it. This may be done, if the growth implicate the edge of the mammary gland, by two incisions that radiate from the nipple as from a centre, thus inclosing a triangular portion of the breast. If it be very movable, and in the substance of the gland itself, it may often be enucleated through a simple incision. In removing this tumour, there are two little practical points that should, if possible, be attended to. 1. The gland should not be incised through its whole thickness, so as to open up the areolar bed which is interposed between it and the pectoral muscle. If this be interfered with, infiltration of blood or of pus into it may occur, and deep abscess may form under the breast or at the lower edge of the gland, leading to very troublesome consequences. 2. The wound must not be closed tightly by sutures and plasters. If this be done, the discharges are retained, and burrowing of unhealthy matter into the submammary areolar tissue often takes place, leading to extensive suppuration behind the mammary gland, often of a most troublesome and tedious character. I have found it better to leave the wound open, and to dress it from the bottom.

When the tumour has been allowed to attain a very large size before removal, it will generally be necessary to extirpate the nipple and the whole of the mammary gland, which will be found either involved in the tumour, or in an atrophied but otherwise healthy state.

**Sarcomatous Tumours** frequently develop in the mammary gland. They are difficult to distinguish from adenomata, but are usually somewhat softer, more rapidly force their growth, and tend to develop at a later period of life in women above rather than in those under thirty years of age. The rapidity of growth of these tumours when soft is very great, and many of the cases that up to a recent period have been described as encephaloid tumours of the female breast, have in reality been these rapidly growing soft sarcomata. Their characters have been so fully described at p. 765, Vol. I., that they need not be recapitulated here. They have also been described as rapidly growing adenomata and "recurring fibroid" tumours. In many cases it is impossible to distinguish them accurately from cancers until after extirpation; and it is to this difficulty of diagnosis, and the confusion that has hitherto existed between sarcomata and cancer—a difficulty that can only be cleared up by the microscope—that "cancer-curers" owe much of their success. Ignorantly confounding the simple with the malignant growth, they claim to have cured the cancer when they have only destroyed the sarcoma.

In some cases sarcoma returns after operation, even though the whole of the mammary gland has been extirpated with the tumour. I believe this to be the case most frequently, if not solely, when the sarcoma is of very rapid growth. In one case, where I had removed a very large tumour of this kind weighing about four pounds, with the whole of the involved and atrophied mammary gland, from a lady forty years of age, in 1859, recurrence took place in 1861, and again in 1863, 1864, 1865, and 1868. The recurrent tumours were developed at some little distance from the original cicatrix, and proved on careful examination to be simple, without any cystic formation or cancerous deposit, or any evidence whatever of malignant action, and were successfully removed. The patient's general health continued perfectly good throughout.

When a sarcoma is not only exceedingly rapid in its growth, but recurs after removal, suspicions of malignancy not unnaturally arise, as two of the most frequent and important elements of such a condition, exuberant vegetative activity and local return, exist. But the absence of all contamination of neighbouring structures, superficial or deep, of glandular implication or of visceral deposit, and of constitutional cachexy, will indicate the benign character of the disease. In such cases as these, the tendency to recurrence will in most cases gradually wear itself out; and, after several operations have been required at intervals of months, or a year or two, the disease will cease to be reproduced, and a cure will be thus established. But instances are not wanting in which the tendency to the local reproduction of the sarcoma has been so active that it out-ran all possibility of complete extirpation, and eventually destroyed the patient. For reference to a case of this kind, see p. 768, Vol. I.

**Painful Mammary Tumour.**—It occasionally happens that the chronic mammary tumour becomes the seat of very severe and paroxysmal neuralgic pains, attended with very considerable cutaneous sensibility, constituting the form of disease that goes by the name of the *painful mammary tumour.* This condition most frequently occurs in early life, and in women of an irritable and delicate constitution; it is commonly associated with disorder of the uterine functions, the pain increasing at the catamenial periods, and appearing to be essentially owing to the implication of some of the twigs of the intercosto-humeral nerves in the disease.

The *Treatment* of this affection must have special reference to the removal of the neuralgic condition. This is commonly best effected by the internal administration of alteratives and tonics, more particularly of the preparations of iron and zinc, with cod-liver oil if necessary; and by the inunction of the iodide of lead ointment, conjoined with belladonna or aconite, into the affected breast. In many cases the application of a few leeches from time to time, especially in the vicinity of the axilla, will lessen the neuralgia more effectually than any other plan of treatment; and in others, again, pressure will be found serviceable. If all other means fail, excision of the tumour may in this, as in the last case, ultimately be found necessary.

CYSTIC TUMOUR OF THE BREAST is one of the most common of the non-malignant affections of this organ. It may occur in three distinct forms: 1. As a Single Unilocular Cyst; 2. As several of these cysts occurring together, a Compound Cyst; and 3. As the Cysto-Sarcomatous Tumour, in which the cystic development appears to be superadded to a structure analogous to that of the chronic mammary tumour. Besides these forms of non-malignant cystic tumour, we occasionally meet with Cystic Cancer of the breast.

1. The **Single** or **Unilocular Cyst** of the female breast, described by Sir B. Brodie as the *Sero-Cystic Tumour*, and by Sir A. Cooper as a variety of hydatid tumour, usually occurs at first in the form of a small thin sac of about the size of a filbert, containing a clear serous fluid, imbedded in the glandular substance of the breast, and movable under the skin. Sometimes more than one cyst of this kind is present in the breast; though, as one attains a greater development than the others, the smaller one may readily escape detection. These cysts when single and small always contain a clear serous fluid, but as they increase in size, or become multiple, their contents may assume a greenish-brown or blackish tinge from admixture with a small quantity of effused blood. They may continue for a great length of time of small size; but in other cases they gradually increase until they contain several ounces of fluid. They then become very tense, with the skin drawn tightly over them, through which they shine if superficial. Sir B. Brodie is of opinion that they are originally formed by a dilatation of the lactiferous tubes, and refers to a preparation in which this position can be demonstrated. This may be the case in some instances, but in most cases they are undoubtedly, as often happens with cystic growths in other organs, of independent formation.

The *Diagnosis* of the affection may usually be readily effected by feeling the globular elastic cyst under the skin ; the mammary gland being movable, and not adherent to any of the adjacent structures. In those cases, however, in which the tumour lies deeply, the diagnosis may not so readily be made, more especially from some of the cystic forms of cancer to which I shall afterwards have occasion to advert. In fact, nothing is more easy than to diagnose the true nature of a superficially seated cystic tumour,—nothing more difficult in some cases than to diagnose one deeply seated at the under surface of the mammary gland. For, the whole thickness of the gland intervening between the cyst and the finger, the sense of elasticity is lost, and a solid feel communicated, which may readily mislead even an experienced Surgeon. Whenever the Surgeon has any doubt about the existence of fluid in a tumour of the breast, he should introduce an exploring trochar ; when, if the disease be cystic, the fluid will be discharged. If the tumour prove to be solid, no ill consequences will result from the simple puncture. Several instances have occurred to me in which, from the want of this simple precaution, very excellent Surgeons had condemned, as cancerous, tumours of the breast which proved to be cystic.

Unilocular cysts of the breast occasionally attain an immense size, at the same time that their walls remain thin and supple. In some of these instances, the fluid continues to the last of a truly serous character ; in other cases, however, it becomes more or less glairy or mucilaginous, and hence Velpeau has described this variety as the *Sero-mucous Cyst.* In other cases, the walls of the cysts have been known to undergo calcareous degeneration. When these cysts attain a very large size, their walls being thin, and the skin covering them tense, they may become translucent, and thus constitute true hydrocele of the breast, resembling in many respects similar serous tumours that form in the neck.

2. **Compound Cysts.**—In the majority of instances, as has already been observed, no material alteration takes place in the cyst, except, perhaps, its gradual increase in size ; but in other instances, peculiar changes occur in it, in consequence of which it becomes filled up by a dense solid growth springing from the interior, at last undergoing ulceration, and giving rise to a series of destructive changes (Figs. 662, 663). The pathological phenomena that accompany these changes have been ably investigated by Sir B. Brodie. He finds that, in the first instance, one or more membranous cysts, containing serum, are formed in the breast ; the fluid gradually becomes darker in colour, and opaque ; after a time a fibrinous excrescence, of a lobulated or foliated form, springs up into the interior of the cyst, gradually displacing and occasioning absorption of the contained fluid, and at last filling up the whole of its interior ; and then coming into contact with the capsule by which it is compressed, or with which it may be firmly incorporated, the whole tumour is converted into a solid mass, in which the remains of the cysts still continue to be perceptible. Sir B. Brodie thinks that there is reason for believing that a growth of a fibrinous substance takes place from the outer side of the cyst as well, thus adding to the general size of the breast. If one of the larger cysts be laid open, or if the pressure of the intracystic growth cause inflammation and ulceration of its capsule, this may at last be perforated, and a fungous mass will sprout through it, presenting

many of the ordinary symptoms of a malignant growth; being irregular, dark-coloured, bleeding readily, and increasing rapidly in size. When such changes as these have taken place, the tumour assumes a formidable character, and will rapidly prove fatal by the induction of exhaustion and hectic. Tumours of this description, composed of cysts having intracystic growths sprouting from

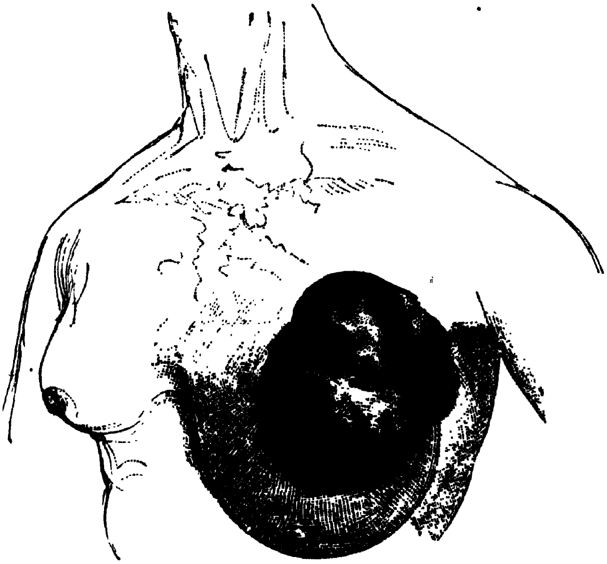

Fig. 662.—Compound Cysts of Breast.

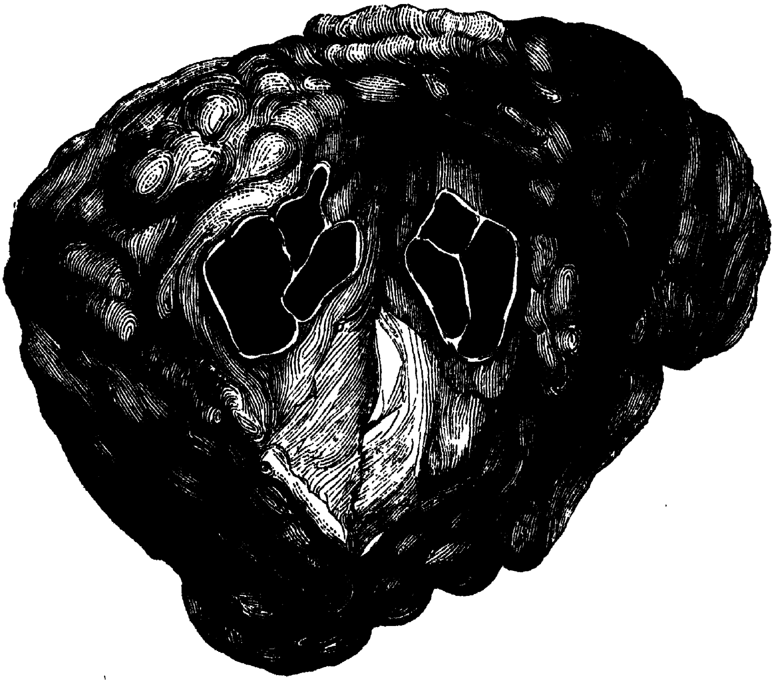

Fig. 663.—Breast laid open after removal, showing Compound Cysts deeply seated in Mammary Gland, mistaken for Scirrhus.

their interior, may attain an immense magnitude and weight. They have been met with of six, eight, or even twelve pounds weight; but by far the largest is one described by Velpeau, which weighed forty pounds.

3. **Cystic Sarcoma.**—The various forms of cystic tumour that have just been described, when associated with the development of fibrinous intracystic matter, constitute forms of the so-called *cystic sarcoma*. Another variety of this disease, however, is not unfrequently met with, in which the sarcomatous or solid element of the tumour preponderates over the cystic part of the growth. In these cases the tumour will be found to be composed of a dense white lobulated or foliated structure, closely resembling that of the chronic mammary tumour, and consisting either of imperfect hypertrophy of the breast-gland, or of the deposit of a fibrinous material. This mass is studded throughout with a number of small cysts, varying in size from a pin's head to a hazel-nut, and usually containing clear fluid. If some of these cysts increase out of proportion to the rest, the tumour will assume more of the true cystic character.

This form of cystic sarcoma usually occurs in women from thirty to thirty-five years of age, as the result of injury or as the remote consequence of some inflammatory action during lactation. On examining a breast affected in this way, it will be found that the tumour, which may either be confined to one lobe or may implicate the whole of the gland, is hard, heavy, and solid to the feel; on careful examination, however, its surface may be felt to be finely nodulated; and, occasionally, a larger cyst than usual may be found projecting, which is recognised by its elastic feel and globular shape. The disease is slow in its growth, and does not implicate the adjacent cutaneous or areolar structures; hence, the tumour is movable on the pectoral muscles, and the skin is unattached to it. The axillary glands, also, are not enlarged, at least not to any material extent. The nipple will usually be found to be normal in its shape, and not depressed.

The eventual development of malignant action in these cystic tumours by the deposit of cancer in the interior of the large cysts must not be overlooked. A tumour of this kind may be benign for many years, and remain generally so throughout the greater portion of its structure; yet, after removal, encephaloid may be found to have formed in some of the cysts. In the case from which the drawings (Figs. 664, 665) were taken, the tumour had existed for more than twenty years before removal, having commenced at the age of twenty-eight; but, after extirpation, cancerous matter was found at the bottom of some of the cysts, which, as the constitution was uncontaminated, was doubtless of recent formation; and the surface of the fungus was epitheliomatous.

*Treatment.*—The treatment of these various forms of cystic and sarcomatous growths varies, according to the number and size of the cysts, and the quantity of solid matter deposited inside and around them. When the cyst is *small* and *single*, the fluid contents may be let out by puncturing with a small trochar; but a cure cannot usually be effected in this way, as the fluid readily reaccumulates. In cases of this kind, Sir B. Brodie found considerable advantage from the application of stimulating embrocations, more particularly of one composed of equal parts of camphorated spirit and weak spirit, with one-eighth part of liquor plumbi. In other cases, blistering and the application of the tincture of iodine may be serviceable. Under these plans of treatment, I have several times seen the tumour disappear. Occasionally it will suppurate spontaneously, and is thus got rid of; or it may be opened, a tent of lint introduced, and thus suppuration established in it.

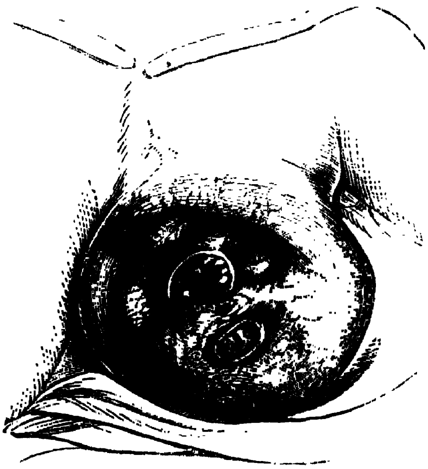

Fig. 664.—Ulcerated Cystic Tumour of Breast, of 20 years' duration.

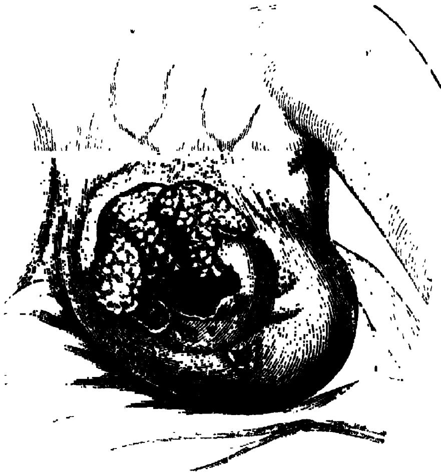

Fig. 665.—The same Cystic Tumour, six months later, with Cancerous Deposit.

**Operative Treatment.**—If the tumour be *unilocular* and *single*, containing serous fluid, possibly with fibrinous matter in its interior, it may often be dissected out of the areolar bed in which it lies, and be separated from its attachment to the mammary gland, this structure and the nipple being otherwise left intact. In this way I have successfully removed large unilocular cysts of the size of a shaddock. If the cyst be *compound* and *numerous*, the case is more serious, and then their extirpation only is not advisable.

When the disease is truly a *Cystic Sarcoma*, it is better either to leave the tumour and treat it by palliatives, or to remove the whole breast; partial removal of the breast, extirpation of the tumour with its lobe of the mammary gland only, is not usually a very successful operation. Recurrence of cystic development will almost certainly occur; and often very severe inflammation of the gland and of the adjacent textures is set up. This I have seen on several occasions, and therefore think it better that the breast should either be left, or removed *in toto*. Such an operation, however, should not be undertaken in the early stages; as the tumour may continue for many years without seriously troubling or endangering the patient, and may perhaps eventually undergo atrophy or absorption. If, however, it show a disposition to increase, to become troublesome by its bulk, or painful, it should then certainly be extirpated; and this operation may always be performed with a good prospect of success, inasmuch as the disease is not malignant, and does not tend to contaminate the constitution. It is a remarkable fact, however, which has been adverted to by Lawrence and Brodie, that, even though the whole of the breast be extirpated, a similar affection occasionally recurs in the cicatrix, requiring subsequent operation; and then, perhaps, being permanently eradicted. This must either be owing to some portion of the cystic structure having been left in the first operation, or to the development of new cysts in the site of the former; but to which cause it is referable, is still uncertain. The repeated recurrence of these cystic tumours is very remarkable. Cæsar Hawkins relates a case in which the growths had to be removed eight times for as many recurrences. After the removal of the cystic sarcoma, a recurrent tumour of cancerous character is sometimes developed in the cicatrix, even in cases in which there is good reason to believe that there has been no carcinomatous element in the primary disease. Yet in other instances it is doubtless owing to the cancerous degeneration of the cystic growth, which may originally have been benign, but in which a malignant action has established itself before removal.

**Sanguineous Cysts** are occasionally met with in the mamma. They present the ordinary characters of cystic development, but are sometimes accompanied by bleeding from the nipples, and, when tapped, are found to contain dark thin grumous fluid.

VARIOUS RARE TUMOURS.—Besides these tumours, the breast is occasionally the seat of other morbid growths; for instance, fibrous, osseous, and cartilaginous masses have been met with. All these affections, however, are of extremely rare occurrence; and, when they form, it is almost impossible to determine their true nature until after removal. Their extirpation is usually practised on account of the obscurity attending the diagnosis, and the fact of their commonly being mistaken for cancerous growths.

The most important of these, perhaps, is a **Recurrent Fibrous tumour**, which shows a remarkable tendency to return after removal. This it may do many—as often as eight or ten—times.

Sir A. Cooper describes a **Scrofulous Tumour** of the breast; the precise nature of which is not very apparent from the account given by that great Surgeon. It is not improbable, however, that it is of tuberculous character; and Velpeau states that he has found tubercle occurring in the breast in two forms: in the first, primarily deposited in the skin and subcutaneous cellular tissue; and in the other, as a fibro-tuberculous affection of the gland itself.

**Hydatids** of the breast are of rare occurrence, and have been principally described by Sir A. Cooper; cases have also been related by Gräfe and others. These hydatid tumours are so excessively rare and obscure, that their true nature would not, in all probability be suspected until after removal. They present the ordinary characters of deeply seated cysts, with fluctuation and some induration round the globular swelling, and an absence of pain. In such a case, an incision into the tumour will cause the escape of the acephalocysts, and the ultimate suppuration of the cavity in which they lodged, which will gradually cicatrise.

In some rare cases, tumours containing **Fœtal Remains** have been met with in the breast: these, however, are rather matters of pathological curiosity than of practical importance.

### CANCER OF THE BREAST.

All the various forms of cancer have been met with in the breast; scirrhus, however, occurs with far greater frequency than any of the other varieties.

Occasionally the encephaloid form of the disease is met with, but colloid is very rare. Cancer of the breast, whatever form it assume, is invariably primary: it may affect one lobe only, or be infiltrated into the whole gland; and it may commence in the nipple or in the skin covering the breast. Most frequently one breast only is affected; but in some cases both mammary glands are implicated.

SCIRRHUS.—Scirrhus is the form of cancer which is commonly met with in the breast. It may occur in several ways: either affecting the nipple, implicating the skin, being primarily deposited in the form of an intramammary tumour; or infiltrating the whole substance of the organ. It most commonly commences as a circumscribed tumour of small size, at first perhaps smooth and round, hard and indolent in its character, with little or no pain; it is readily movable, may be situated in one lobe, and is attached perhaps to the rest of the gland by a distinct pedicle. As it increases in size, it becomes hard, knobbed, and irregular, perhaps presenting a finely granular feel, and becoming fixed to the gland and subjacent parts. When the disease begins as scirrhous infiltration of the breast, the mass is from the first hard, rugged, irregular, nodulated, and heavy; often somewhat square in shape, and early accompanied by adhesions to subjacent parts. In other cases, the development of the scirrhous mass is accompanied by a corresponding atrophy of the mammary gland, which becomes shrivelled and disappears entirely. In some instances, rather large cysts may form in connection with the scirrhous mass. In a woman, whose breast I once removed for what was supposed to be cystic sarcoma, but which proved after the operation to be a scirrhous tumour, the mass contained several cysts as large as cherries, filled with dark or greenish fluid, and projecting from its surface; and in a lady under my care for scirrhus of the breast, a tumour as large as a pigeon's egg, containing sanguinolent fluid, formed on the surface of the tumour.

As the swelling increases in size, it has a tendency to be more fixed to the subjacent parts, becoming adherent to the pectoral muscles and incorporated with the areolar tissue at the border of the axilla. The tumour also begins to form a distinct external projection, and becomes more irregular in shape; it is the seat of severe pain, more particularly at night; and is usually covered by a plexus of blue and dilated veins. The ordinary symptoms of cancerous cachexy now appear, and the disease then makes still more rapid progress.

The tumour may in some cases remain for a great length of time without implicating the **Skin**; but most commonly, after it has existed for a few months, this tissue becomes more or less involved in the morbid action. Instead of being loose and movable over the surface of the cancer, it will be found, on being pinched up between the fingers, to dimple at one part, where it may be felt to be attached by a kind of cord-like process to the tumour beneath it. After a time, that portion of the skin which first became fixed in this way acquires a reddish or purplish colour, and is covered with thin scaly epidermic desquamations, and becomes permeated by a number of small ramifying vessels. A crack or fissure eventually forms in this; a small exudation of a mucous fluid takes place, which dries into a scab; under this, ulcerative action sets in, which speedily assumes the ordinary characters of a scirrhous ulcer, having hard, elevated, and everted edges, a greyish-green or foul surface, and discharging a quantity of very fetid pus. In some cases ulceration may take place at several points, and thus the whole surface of the breast become converted into one immense chasm, which may even extend up into the axilla.

The skin, when affected, often assumes a red, glazed, hard, and brawny character, being shining, and as if greasy upon the surface, having its pores enlarged, and enveloping the side of the chest in a kind of stiff solid casing, attended usually by much pain, considerable œdema of the arm, and an aggravated form of constitutional cachexy: ulceration at last takes place in this hardened mass, and then speedily destroys the patient. In other cases, the cancerous development seems to develop primarily, and to expend its energy chiefly upon the cutaneous structures. The tumour of the gland is small, atrophic, and implicates the nipple. The cancerous infiltration rapidly spreads into the surrounding integument, which becomes early contaminated, assuming a hard, leathery character, or feeling brawny and infiltrated; often without discoloration, but presenting a hypertrophied appearance, the pores being enlarged, and the interspaces between them increased. In other cases, the infiltrated skin assumes a brownish or purplish colour, and is covered by rough desquamating crusts, so as to resemble the bark of an old tree. This diseased state of the integuments will extend very widely, without ulceration or further development of the tumour situated in the gland. I have in this way seen the integuments of the whole front of the chest, from the clavicles to below the mammæ, and from one axilla to the other, infiltrated, hard, and leathery, of a brownish-red colour, forming a stiff cuirass, as it were, but without ulceration. This condition is very chronic; and it is remarkable that in it the axillary glands are not infiltrated, or the constitution rendered cachectic, at nearly so early a period as when the disease primarily originates in the mammary gland, and secondarily involves the skin.

Another way in which the skin becomes involved primarily, is by the formation of a scirrhous tubercle or nodule in it, usually towards the outer or axillary border of the mamma. From this the disease gradually infiltrates inwards, implicating the gland in a secondary manner, and usually but to a limited extent.

The **Pain** is in many cases but trifling in the early stages of the affection; so much so, indeed, that it is the tumour, often accidentally noticed, that first excites alarm; as it increases, however, the suffering becomes severe, more particularly at night, is greatly aggravated by handling the diseased mass, and chiefly extends up to the shoulder and down the arm. The pain usually becomes most severe about the time when the skin is first implicated; but, as the cutaneous infiltration goes on, it gradually lessens, owing probably to the destruction of the cutaneous nerves.

**Retraction of the Nipple** commonly commences about the same time that the skin is implicated; it appears to be owing to the glandular substance becoming involved in the mass of the tumour, and thus giving rise to shortening of the lacteal ducts; in consequence of which, by the projection forwards of the general mass of the breast, the nipple appears to become completely buried. This sign has received more importance than it deserves in connection with cancer, as it does not occur in all cases of malignant disease, and is occasionally met with in simple mammary tumours.

The **Axillary Glands** usually become enlarged early in the disease, and may attain a greater size than that of the original tumour; and on close examination a kind of indurated cord may be felt extending in the course of the absorbents, from the edge of the pectoral muscle to the axilla. After a time, the supraclavicular or subclavicular glands may likewise become implicated. In fact, the whole of the glandular structures in the vicinity of the shoulder undergo cancerous infiltration. When this is the case, the pressure upon the axillary vein may occasion œdema of the arm and hand. The glandular infiltration usually increases rapidly after the skin has become implicated. In some cases, scirrhus of the axillary glands is the primary disease: and in other instances, when the glands become affected, the chief virulence of the disease appears to expend itself upon them; the tumour of the breast ceasing to enlarge, or even wasting, whilst the secondary glandular deposits in the axilla become greatly developed.

As the scirrhus extends, it may gradually affect the subjacent muscles, cellular tissue, the ribs, and at last the pleura, giving rise eventually to hydrothorax or secondary visceral deposits. In many instances, however, the disease proves fatal by the induction of exhaustion. The constitutional cachexy is in many cases not very distinctly marked, until after the skin has become involved; but then it rapidly increases, more especially when ulceration takes place. Indeed, the cancerous degeneration of the skin may be looked upon as an epoch of peculiar importance in scirrhus of the breast, as it is at this period that the pain increases, that the lymphatic system becomes infected, and that the constitution becomes distinctly poisoned.

**Duration.**—The duration of life after the occurrence of scirrhus of the breast varies greatly; so much so, that the disease may be considered as assuming an acute and a chronic form. The acute variety principally occurs in ruddy and plethoric women, and commonly proves fatal in a few months. In those who are of a more feeble and delicate constitution, the disease, as a general rule, takes a slower course. Sir A. Cooper states that the disease, on an average, is from two to three years in growing, and from six months to two years in destroying life after being fully formed. In this estimate, which is probably correct, Walshe agrees; so that the average duration of life in cancer of the breast would probably be about three years. As a general rule, the progress of scirrhus is slower in old people, in whom it occasionally gives rise to a kind of atrophy of the breast, with shrinking and induration of the tumour. There are many instances on record, however, in which cancer of the breast has existed for a far longer period than has just been mentioned; for ten, twelve, or even, as in a case related by Sir B. Brodie, for twenty-five years.

**Pathological Structure.**—After removal, scirrhus of the mamma presents considerable variety in appearance. In the majority of instances it occurs as a peculiarly hard, knobbed, and irregular mass, creaking under the knife when cut, and presenting on section a greyish or bluish-grey, semi-transparent surface, traversed in various directions by bands of a more opaque character, and exuding on pressure a thin reddish juice. In many instances, masses of an opaque appearance and yellowish tint may be seen in the midst of the tumour. These, which look like tuberculous deposits, consist in reality of fatty degeneration of the scirrhous structure. In other cases again, on pressing the tumour, small drops of a thick creamy fluid will appear to exude at various points. This seems to be the inspissated and altered secretion of the gland retained in the ducts. Cysts are occasionally, though rarely, met with in scirrhus of the breast; these are usually small, and contain clear fluid, being deeply imbedded in the substance of the tumour; in other cases they may be large and globular, and filled with a bloody or dark-green liquid. The microscopical characters of scirrhus of the breast are such as are represented in Fig. 305 and 306, Vol. I.

ENCEPHALOID.—Encephaloid of the mammary region and gland is by no means of such common occurrence as scirrhus, yet all the varieties of this form of cancer have been met with in the breast; and fungous hæmatodes has been seen to spring from the bottom of cystoid growths previously developed in this region. Encephaloid of the breast may sometimes acquire a considerable size; thus, Cruveilhier relates a case in which the tumour weighed nearly twelve pounds. The structure of this disease does not differ from that of the same affection in other situations; both the hard and the soft varieties may be met with, and in some advanced cases the true fungus hæmatodes occurs. But undoubtedly many forms of rapidly growing and fungating tumour of the mamma, which up to a recent period were considered, described, and figured as encephaloid, are in reality not cancerous at all, but simply forms of soft sarcoma, with a tendency to rapid growth, fungous sprouting, and interstitial hemorrhage.

Encephaloid usually begins deeply in the substance of the breast, though sometimes, but more rarely, at a little distance from the gland, as a soft globular tumour, which rapidly increases in bulk; the integuments covering it are not at first adherent, but are usually pushed before it, and speedily become permeated by a largely ramified network of veins. In some cases I have seen the integuments, early in the disease, œdematous and inflamed, so as to mask the subjacent tumour. The mass at first feels as if composed of several soft and rounded tumours, which communicate an obscurely fluctuating sensation, perhaps causing the Surgeon to mistake the growth for a cystic formation or an abscess; with which it is especially apt to be confounded in those cases (rare, it is true) in which the skin is inflamed and œdematous. The breast now rapidly assumes a very prominent and conical form; the skin covering it at its most projecting part becomes thinned and reddened, and at last gives way, leaving a large circular ulcer, from which a fungous mass of greyish or reddish-brown colour speedily sprouts up, with a good deal of discharge of a foul, bloody, and offensive character. From this, disintegrated masses are occasionally detached by a kind of sloughing action; and cases may even occur in which the whole of the fungous protrusion sloughs away, and cicatrisation taking place, a tolerably perfect cure may result. These instances, however, are so rare as scarcely to influence our prognosis of the necessarily fatal character of the affection. Implication of the glandular structures in the vicinity of the tumour, followed by constitutional cachexy, occurs in this as in true scirrhus of the breast. The progress of the disease is always extremely rapid, particularly in young and otherwise healthy subjects.

Colloid of the breast is of rare occurrence, and, when met with, is usually associated with scirrhus or encephaloid. It may, however, occur singly; and, slowly growing, may attain a very large size. I have removed from the breast of a lady a colloid tumour which, after growing for five years, had attained a weight of six pounds. Its colloid character was established after careful examination by G. Harley. In this case the tumour was smooth, somewhat lobed, but not adherent to the skin or subjacent parts. On section after removal, it was found to be of a yellowish-brown colour of varying shades, and composed of a dense, smooth stroma, with numerous loculi and sacs filled with glairy, transparent colloid matter.

**Causes of Cancer of the Breast.**—These are usually extremely obscure.

*Sex* is certainly the circumstance that has the most marked influence on the occurrence of mammary cancer, the disease being, as is well known, almost entirely confined to women; yet instances in which this affection is met with in the male breast occasionally occur. Its peculiar frequency in the female may possibly be owing to the great and sudden alternations of the functional activity of the breast in women. The changes impressed upon this organ at puberty and during pregnancy, the various alternations which it undergoes, the inflammatory affections to which it is subject during lactation, the frequent irritation to which it is exposed by sympathising with uterine derangement, and the diminution in its vital activity that takes place at the change of life, are sufficient to explain the great liability of this organ to disease generally; and may not improbably give a clue to the reason why it is peculiarly the seat of cancer in women.

*Age.*—The age at which cancer of the breast most frequently occurs is between the thirtieth and fiftieth years. According to Birkett, it is most commonly met with between the ages of forty-five and fifty—a period of life that is popularly looked upon as specially obnoxious to this malady. At these ages, cancer of the breast usually affects the form of scirrhus. When it occurs, as it very rarely does, in early life, it more frequently assumes the encephaloid character. I have, however, removed a scirrhous breast from an unmarried woman twenty-three years of age. In elderly women also, scirrhus is the prevalent form; though I have seen several instances of encephaloid at an advanced period of life, one case in a woman upwards of seventy years of age. Indeed, cancer in either form may affect this organ up to the latest period to which life is prolonged. Married women are said to be more liable than single ones to cancer of the breast; it may, however, fairly be doubted whether they are proportionately so; and it is a common belief, founded, I think, in some degree on truth, that the disease is most common in women who have not borne children.

*Injuries* inflicted upon the breast, such as blows, squeezes, &c., are commonly referred to, and are greatly dreaded by women, as the causes of cancer. That they might be so in constitutions otherwise predisposed to the affection, does not appear improbable; and that they are so in reality in many cases, I have not the least doubt. The number of instances that have fallen under my observation, in which a blow or squeeze of the breast has speedily been followed by the appearance of a cancerous tumour in it, leaves no doubt whatever on my mind of the truth of the popular belief that associates the injury with the disease, in the relation of cause and effect. *Lacteal inflammations* are likewise frequently supposed to tend to the production of cancer of the breast. Of this doctrine, I think that we do not possess at present sufficient proof; though it appears highly probable that disturbance of the functions of the organ during lactation may predispose to the occurrence of this disease.

**Diagnosis.**—The diagnosis of cancer of the breast from other diseases affecting this organ is of the first importance, and is attended by corresponding difficulties. The great point is to determine whether the tumour of the breast be of a cancerous character or not; that the Surgeon should go beyond this, matters little in practice—and, indeed, except in some of the forms of cystic disease of this organ, few practitioners would feel disposed to endeavour to carry their diagnosis beyond this point. The great and essential difficulty in determining the nature of a tumour of the breast consists in the fact of the same signs being more or less common to many growths in this region; a hard, circumscribed, indolent mass, chronic in its progress, with a certain amount of pain, being the usual characteristics presented by all solid mammary tumours; and though in nine cases out of ten a tumour presenting these characters, which has existed for a year or more in an elderly woman, and has resisted ordinary absorbent and alterative treatment, is scirrhous, yet instances of the reverse occasionally occur. Nothing can better exemplify the difficulty of diagnosis in tumours of the breast, than the circumstance, which is not unfrequently witnessed, that after the removal of the diseased mass, its section, and careful examination, Surgeons of equal experience will differ as to whether it be malignant or not, and to what class of affections it should be referred; and, indeed, in many of these cases it is impossible to ascertain its precise nature without having recourse to microscopical observation.

It is extremely difficult to lay down any definite rules of diagnosis by which the question as to the malignancy of a tumour of the breast can be solved. In the majority of cases of *cystic growth* in this region, there is little difficulty; the existence of cysts of sufficient size to be readily felt or seen through the skin being generally characteristic of the non-malignant cystic growths. It must be borne in mind, however, that cases, such as one to which allusion has already been made, may occur, in which cysts are conjoined with cancerous development.

The diagnosis between *cystic sarcoma* and some forms of *cystic cancer* of the breast is not always easy; indeed, it may be impracticable, and only be determinable after removal by microscopic examination. I have had in the Hospital a patient fifty-nine years of age, in whose breast a hard tumour, as large as half an orange, had existed for five years; it was perfectly and freely movable, unconnected in any way with the skin; there was no retraction of the nipple, and no lancinating pain. On its upper side, several large cysts could be felt, and seen through the skin. On examination after removal, it was found to be encysted scirrhus, with large cysts of the size of cherries, containing bloody and yellow fluid. The only very suspicious circumstances here were the age of the patient, and the existence of one small indurated gland in the axilla.

In these cases of doubt, the safer plan is always to make an exploratory puncture, and, if necessary, to examine under the microscope the contents withdrawn by the groove in the needle or by the trochar; indeed, if there be the slightest doubt as to the nature of the tumour, this exploratory puncture should never be omitted before its removal is determined upon. I have more than once seen tumours which had been positively pronounced to be scirrhous, and for which amputation of the breast had been recommended, prove to be cystic, and disappear entirely when their contents were withdrawn.

Between cancer and the *ordinary solid tumours* of the breast, more especially the sarcomata, the diagnosis is often extremely difficult; but we may arrange the chief signs of the two forms of disease in distinct groups, when, by comparing them together, the differences may be more clearly seen. (*See* Table.)

| NON-MALIGNANT TUMOURS. | SCIRRHOUS TUMOUR. |
|---|---|
| *Feel.* Moderately hard, nodulated, irregular in shape; occasionally more or less lobed; not very distinctly circumscribed; sometimes elastic in parts. | *Feel.* Of stony hardness, knobby and distinctly circumscribed, or somewhat square, and occupying the whole of the substance of the gland. |
| *Mobility.* Considerable, though occasionally there is a deep pedunculated attachment. | *Mobility.* At first considerable, but soon becomes fixed to the deeper structures by a broad attachment. |
| *Skin.* Of the natural colour throughout, though thinned and expanded with the tumour lying close beneath it. Only implicated in the advanced stage of cystic sarcoma. | *Skin.* Early implicated—at first dimpled, then red or purple, and in other cases brawny and leather-like, so that it does not admit of being pinched up into folds; or nodulated; purple-red masses form in it. |
| *Nipple.* Usually not retracted. | *Nipple.* Usually retracted. |
| *Veins of the Skin.* Not much dilated. | *Veins of the Skin.* Very greatly dilated. |
| *Pain.* Often moderate, if severe, continuous or of a neuralgic character, much increased by handling. | *Pain.* Severe and lancinating, especially at night after handling, and when the skin is implicated, but not continuous. |
| *Axillary Glands.* Of usual size, or but slightly enlarged and movable. Lymphatics not affected; supraclavicular glands not affected. | *Axillary Glands.* Enlarged, indurated, and fixed. Indurated mass of lymphatics under and parallel to edge of the pectoral, stretching into the axilla; supraclavicular glands enlarged. |
| *Constitutional Infection.* None. | *Constitutional Cachexy.* As disease advances. |

*Rapidity of growth,* although always a very suspicious circumstance, cannot by itself and without other signs be taken as unequivocal evidence of malignancy of action. I have seen a so-called "chronic mammary tumour," probably a sarcoma, increase from the size of a hen's egg to that of the adult head in less than six months, and after removal not present the slightest evidence of malignant disease, on the most careful examination.

*Recurrence after removal,* though a very suspicious circumstance, is by no means a proof of malignancy. Rapidly growing sarcomata will recur. This I have seen happen five times in a lady, otherwise in perfect health, and without a trace of malignant disease in the system or in the tumour (*see* page 584). So also the recurring fibroid tumour has been removed eight or ten times from the breast, before its complete extirpation has been effected.

TREATMENT.—In cases of cancer of the breast, the first question that presents itself to the Surgeon is, whether any plan of treatment short of the removal of the tumour holds out a prospect of cure, or even of relief; and if not, whether the extirpation of the cancerous breast can be undertaken with a prospect of ridding the patient of an otherwise fatal disease, or at least of prolonging her existence. To these questions the remarks made at pp. 799 *et seq.*, Vol. I., on the general treatment of cancer, may be considered applicable. The management of cancer of the breast, however, involves so many special considerations of importance, that it becomes necessary to consider its bearings somewhat in detail.

No constitutional means appear to be of the slightest service in arresting, and still less in removing, cancerous tumours of the breast. The advantages stated to have been derived from the use of arsenic, conium, iron, various preparations of mercury, &c., have not been borne out by experience; and, indeed, it may be stated generally that these and all other known remedies are perfectly valueless in the curative treatment of this disease.

**Compression** by various means, whether by plasters, as employed by Young; by agaric, as used by Recamier; by the spring-pads of Tanchou; or by the slack air-cushion of Arnott, has been much praised, not only as a palliative, but as a curative means of treatment in this disease; and cases are recorded, which, however, even the warmest advocates of this plan of treatment are forced to admit to be altogether exceptional, in which the employment of this means has been stated to have effected a complete removal of the tumour. But, although I am not prepared to deny that hard and chronic tumours of the breast may have become absorbed during the employment of this treatment (and indeed I have had occasion to observe this in my own practice, in cases of chronic mammary growth), I think that evidence is altogether wanting to show that an undoubted case of cancer of the breast has ever been cured by this means. And, notwithstanding the high authority with which some of these alleged cures of cancer have been brought before the profession, no positive proof has been adduced to show that the tumour that was observed was really and truly of a cancerous character, and that it may not have been either a chronic mammary tumour, or an encysted abscess of the breast. Every practical Surgeon well knows that it is utterly impossible, in the present state of science, to diagnose in many cases with complete certainty the true nature of a tumour of the breast, and must frequently have witnessed cases in which, after extirpation, the morbid growth has been found to be of a different character from what had originally been supposed. I am acquainted with at least eight or ten cases in which some of the most experienced Surgeons, both in this country and in Paris, have amputated the breast for supposed scirrhus; when, after removal, it was found simply to have been the seat of a chronic abscess with very dense walls. And with regard to a hard, chronic, and indolent tumour of the breast, few Surgeons will hazard a positive diagnosis as to whether it is scirrhous or not, until they have actually seen a section of it; and even then it often happens that men of equal experience will differ in the judgment they pronounce as to its nature. For these reasons, it is impossible not to receive with the utmost hesitation the cases of supposed cancer of the breast reported as cured by the advocates of compression, and not to suspect that the cases recorded by these gentlemen as instances of the successful employment of this plan of treatment may have been other chronic tumours of the breast, than those of a cancerous character.

But, though there is no evidence before the profession to prove the utility of compression as a *curative* agent in cancer of the breast, I think that, when practised with Arnott's slack air-cushion, or Tanchou's spring-pad, it is of considerable value as a *palliative* in some of the earlier stages of this disease; when it may undoubtedly occasionally arrest its progress for a time, diminish the size of the swelling, and lessen the violence of those attacks of lancinating pain which are so distressing to the patient. In conjunction with the pressure, much relief to suffering may be afforded by the use of belladonna plasters, or of atropine or aconite inunctions, together with the internal exhibition of conium, and morphia or hypodermic injections of morphia and atropine.

In the advanced stages of the disease, however, when the skin is involved, the pressure is often unbearable, increasing the pain, and acting as a source of irritation to the patient. In some cases of this kind, in which the slack air-cushion could not be borne, I have seen relief afforded by moderate pressure with thick layers of amadou, supported by an elastic bandage, belladonna or conium in powder being dusted on the innermost layer of amadou. A very thin gutta-percha shield, moulded to the part, may sometimes be advantageously applied over this, and kept on by turns of an elastic roller. When the skin is implicated and very tender, the application of belladonna and lead lotion is of use. When the disease has run into an ulcerated stage, the internal administration of conium, so as to blunt the sensibility, and the local application of chlorinated lotions to lessen the fetor, together with the application of the watery extract of opium or of belladonna, will relieve. In cases of this kind, the application of caustics has been greatly vaunted, and portions of the diseased surface may be cleansed or removed by these means. The employment of the various antiseptic dressings that are familiar to all Surgeons is of much service in the advanced stages of ulcerated cancer of the breast, removing fetor, and lessening the inflammatory irritation occasioned by the decomposition of the cancer matter.

**Caustics**, applied in accordance with the principles laid down at p. 801, Vol. I., may occasionally be advantageously employed in the treatment of cancer of the breast, when excision is not practicable: as when the patient is alarmed at and positively refuses to submit to the knife; when she is anæmic or aged, so that the effects of loss of blood are to be dreaded; or when the cancer is already ulcerated.

**Operation.**—The constitutional and ordinary local treatment of cancer of the breast being thus, at the most, of a palliative character, the question of operation always presents itself at last. The objects proposed are, in the first place, by the extirpation of the diseased breast, to prevent constitutional infection, and thus permanently to free the patient from her necessarily fatal affection; or, failing in this, to retard the progress of the constitutional infection, and thus at least to prolong existence. How far these objects are attained by amputation of the cancerous breast is a subject of important inquiry to the Surgeon. The operation has been discountenanced by many excellent pathologists; not so much from any intrinsic danger it may possess, for, although occasionally fatal from erysipelas or some similar accidental complication, there is nothing specially hazardous about it; nor from its being now, as formerly, open to the objection of subjecting the patient to unnecessary pain, all suffering during its performance being prevented by anæsthetics, and little inconvenience being experienced at subsequent dressings, which are usually nearly painless; but the great objection lies in the fear of the disease, in many cases, returning and running its course as rapidly after the operation as if none had been performed, and in others perhaps even more rapidly.

The principal points in connection with the operation appear to resolve themselves into two questions:—1. In any case of cancer of the breast, may constitutional infection be prevented by amputation of that organ; and, if so, under what circumstances will this most probably happen? 2. Although the disease may eventually return in the part or elsewhere, may not excision arrest the rapidity of the fatal termination? (*Vide* p. 806 *et seq.*, Vol. I.)

1. To the first question, it is not easy to give a very definite reply. Nothing shows more clearly the utter worthlessness of many so-called surgical statistics, than the discrepancy that exists between those which have been published as exhibiting the liability to relapse of cancer after operation. Thus, Hill states that out of 88 cancers on which he had operated, at least two years before the return was made, there were only ten relapses, and 2 deaths; whilst Alexander Monro states that, out of 60 cancers which he had seen removed, in only 4 patients was there no relapse at the end of the second year. Boyer saved one only in 25, and Macfarlane gives a still more unfavourable account of his practice; for he says that, out of 32 cases of cancer operated upon by himself, there was not one instance of radical cure; and of 80 other cases with which he was acquainted, the result was in every instance unfavourable. Warren, on the other hand, saved 1 in 3; and Cooper 1 in 4. Amidst such conflicting statements as these, it is clearly impossible to eliminate more than the general fact, which is well known to every Surgeon; that, in a large number of the cases of cancer operated upon, there is a tolerably speedy return of the disease. In these cases there are, however, many points to be taken into account, of which gross statistics can take no cognisance; much being necessarily dependent upon the skill with which the operation is performed, as well as upon the care employed by the Surgeon to cut widely of the disease, and to extirpate completely not only the whole of the morbid mass, but those tissues in its neighbourhood which appear to be implicated in however slight a degree.

In many of these cases, also, it is by no means improbable that the practice, at one time rather generally followed, may have been adopted, of merely extirpating the tumour without removing the whole of the breast. I am therefore disposed to look upon any deductions based upon the statistics of Hill, Macfarlane, and Benedict, as of very little if of any value when applied to the surgery of the present day. This is more especially the case from the fact, already adverted to, that it is only comparatively recently that it has been possible to distinguish, even after removal, certain forms of sarcoma from cancer, and that all statistical statements in reference to the question of recurrence of cancer of the breast after operation, made anterior to this period, must be utterly valueless, inasmuch as hard sarcomata were generally mistaken for scirrhus, and the soft and rapidly growing ones were confounded with encephaloid.

The only inference fairly deducible from those inquiries is that in a certain proportion of cases, whatever the precise ratio be (and this is still undetermined), a disease supposed to be cancer has been effectually removed by extirpation of the breast.

2. As to the second question,—whether as a general rule life may not be prolonged by the performance of the operation,—it would appear, if the statistics collected by Leroy D'Etiolles be accurate, that hitherto it has not been so. Walshe comes to the conclusion that the operation cannot, as a general rule, be regarded as a means of prolonging life, but that in the majority of cases, death is hastened by such interference. Sir A. Cooper and Sir B. Brodie both agree that, in most cases, the disease returns in two or three years after the operation, and then kills the patient.

But, though the general result of a statistical inquiry into this subject, based upon the imperfect materials and probably very incorrect figures at present before the profession, leads to the conclusion that operation for cancer of the breast, when indiscriminately performed, has hitherto not only failed to cure the disease, but has actually in a great number of cases hastened its fatal termination, yet it must be admitted that instances have occurred in which life has been prolonged by this means considerably beyond its average duration in this disease. Thus, Callaway operated on a case in which no return took place for twenty-two years. Velpeau states that he removed encephaloid tumours of the breast, and that the patient remained free from the disease for eight or ten years. Sir B. Brodie and other Surgeons relate similar instances in which the patient's life has been prolonged for many years after the operation; and the experience of the most eminent practical Surgeons is decidedly in favour of having recourse to it under certain circumstances.

But, high as is the authority that must necessarily attach itself to the statements of such great Surgeons as Velpeau and Brodie, it is impossible not to suspect that some of the tumours may not have been cancers, but only sarcomata, which the means of diagnosis possessed by these eminent men were insufficient to distinguish from true cancers in all cases.

The most trustworthy statistics that we possess on the relative duration of life in cases of cancer of the breast, with or without operation, are those collected by Sir James Paget, Morrant Baker, and Sibley. Paget states that, of 113 cases, 66 were not submitted to operation; of these the average duration of life was a little more than 48 months. Of 47 operated on, the corresponding average was also a little more than 49 months. In the first two years of the disease the proportion of deaths was much less in those operated on than in those who were left—being in the former 24 per cent., in the latter 36 per cent. The longest duration of life in cases not operated on was 18 years; in those operated on, a little more than 12 years. Morrant Baker finds that in 84 cases in which no operation was performed, the average duration of life was 48 months; in 62 cases operated on, the average was 56½ months. Sibley finds that the average duration of life in unoperated cases was about 32 months; whilst in those subjected to amputation of the breast it reached 54 months. Thus it will be seen that, independently of the possible chances of a complete cure, the operation holds out the prospect of an average gain of nearly two years of life.

There is, however, another point of view from which these operations may be considered; for, even if they do not prolong life, they may greatly improve the patient's condition, and place her in a state of comparative comfort during the remainder of her existence. Thus, she may be suffering so much pain from the local affection, or, if the cancer be ulcerated, may be so much annoyed by the fetor of the discharges, that she may be placed in a position of far greater comfort by having the local source of disease and irritation removed; and though she die eventually of cancer, it may be with much less suffering to herself and others for her to be carried off by cachexy with secondary deposits in the lungs or liver, than to be worn out by the pain, discharge, and hæmorrhages, of a slowly progressive ulcerating cancerous mamma.

The question as to the advisability of operation in any given case of cancer of the breast cannot, however, be determined by abstract pathological reasoning, by reference to scientific principles, or by calculations founded on statistical results. The Surgeon must minutely examine and attentively weigh all the circumstances of the particular case before him, and he must endeavour to distinguish those cases in which the operation may possibly be the means of preserving or prolonging life, from those in which there is no prospect of its being of any service, or in which indeed it must inevitably hasten the patient's death. Whatever the value of statistics may be in determining the question, whether in cases of cancer of the breast generally the operation will effect a cure or prolong life, they are not equally valuable in their application to individual cases. When a Surgeon is called on for his opinion respecting the propriety of amputating the breast of the patient before him, it is not sufficient for him to be able to state what the general result of the operation may be, but he must be able to satisfy himself whether the particular instance under consideration may or may not be one of those cases, exceptional perhaps, in which there is a possibility of extirpating the disease entirely from the system, or at all events of prolonging the patient's existence. In order to do this, it is necessary to endeavour to lay down some rules that may guide us in selecting those cases in which the operation may be advantageously done, and in setting aside others in which we know that it will almost to a certainty hasten the patient's death. And, indeed, it is the absence of all such considerations in general statistical investigations into the results of operation for cancer, that deprives them of much of their value as guides in actual practice.

Though nothing can be more unsurgical or improper than the indiscriminate extirpation of cancerous tumours of the breast from all patients who may present themselves in whatever stage of the disease; and though such a practice would doubtless be followed by fully as disastrous results as those that occurred to Macfarlane, Benedict, and others; yet there can be little doubt that a Surgeon who would employ a certain principle of selection, would obtain a very different and a far more successful result in his practice. Sir B. Brodie has very clearly and succinctly pointed out the most important circumstances by which the question as to the propriety of operating in these cases should be determined. Before doing so, he very justly dwells on the fact that in many cases the operation may fail, and the disease speedily recur, through the negligence of the Surgeon in leaving portions of the gland, slices of the tumour, or contaminated tissues, and that thus the operation may receive discredit for what is in reality the fault of the Surgeon who has performed it.

With reference to operation, cancerous diseases of the breast may be divided into three classes :—1. Those in which it is the duty of the Surgeon to discountenance excision ; 2. Those in which operation is of doubtful expediency ; and 3. Those in which it is the duty of the Surgeon to recommend it.

1. **Cases unfit for Operation.**—This class includes cases presenting the following conditions : *a.* Strongly marked constitutional cachexy ; *b.* Disease in both breasts ; *c.* Secondary deposits in internal organs ; *d.* Much enlargement of the glands under, and especially of those above, the clavicle ; *e.* Adhesion of the tumour to the ribs and intercostal muscles ; *f.* Hard, brawny, and infiltrated skin, of a reddish-brown colour, having a hard, leathery feel, or a greasy, glazed appearance ; *g.* Rapid growth of the tumour in a patient with a strong hereditary taint ; *h.* An extensively ulcerated and fungating tumour.

2. **Doubtful Cases.**—*a.* If the patient be aged, weak, or anæmic, and the tumour large, it is seldom expedient to operate, as the shock may destroy life. *b.* When the skin is merely dimpled in by a kind of pedicle passing from the tumour to its under surface, an operation may be performed, unless other circumstances should contraindicate it ; but in such cases it is necessary widely to excise the integument surrounding the attached point. The cancer-cells, as I have more than once had occasion to observe, will have diffused themselves extensively through the neighbouring skin, which, to the naked eye and to the touch, has a perfectly healthy appearance, the tumour being surrounded by a kind of halo or atmosphere of cancer-infiltration. *c.* When there is but moderate enlargement of the axillary glands, which are so situated as to admit of removal, the operation may be performed. *d.* When the cancer is ulcerated, it is seldom proper to operate ; but, if all other conditions be favourable, this even need not in some special cases be a bar. As Sir B. Brodie has pointed out, the patient's existence may sometimes in these cases be prolonged, and her comfort materially increased, by removing the diseased and ulcerated mass.

Old age exercises a material influence on the expediency of operating for cancer of the breast. As a rule, I do not think it advisable to do so after seventy years of age, unless the distress from pain or the discomfiture from fetid ulceration be so great as to render removal at any risk justifiable. The danger of the operation is greatly increased by advanced age, more especially if the patient is stout ; and if recovery take place the expectancy of life after seventy would not be materially, if at all, increased by the extirpation of a disease which would probably recur in a fatal form within two years ; the more so, as the progress of cancer at advanced age is often very slow.

3. **Cases favourable for Operation.**—The exclusion of all the cases that fall under the preceding categories will necessarily limit very materially those in which an operation may be undertaken; it can, however, be performed with every prospect of its being advantageous to the patient, if the tumour be of moderate size, slow or nearly stationary in its growth, unconnected with or at least merely attached by a pedicle of the skin, pretty distinctly circumscribed, movable on the subjacent parts, and not complicated by enlarged glands in the axilla or elsewhere. The patient has an especially good prospect of recovery, according to Brodie, if the disease be seated in the nipple.

When once a tumour of the breast has been ascertained to be of cancerous character, the sooner it is removed the better, unless one of the special reasons adverse to operation that have just been adverted to should exist. I cannot conceive that any good can come of delay in these cases. The disease (for reasons stated at pp. 791—810, Vol. I.) appears in the early stages often to be entirely local: there is no evidence of constitutional infection, but if the operation be delayed the skin speedily becomes implicated, the axillary glands enlarge, and cancerous cachexy sets in. As a general rule, it may be stated that in all cases of cancer of the breast the whole of that organ ought to be freely removed, especial care being taken that no slices of mammary structure be left behind; and after removal the under surface and edges of the gland ought to be carefully examined, with the view of seeing that the extirpation has been complete. When the cancer is infiltrated, the whole of the breast and the surrounding cellulo-adipose structures must be very freely removed, as there is often a halo of cancer-deposit around the morbid mass, in tissues apparently healthy. It may happen that the tumour, especially if scirrhous, is apparently isolated, and situated at one border of the gland, scarcely, if at all, connected with that structure. Here the question will arise, as to whether the whole of the organ ought to be removed or not. In determining this we must, I think, be guided by the position of the scirrhous mass and the size of the breast. The cancer-infiltration proceeds in the course of the lymphatic vessels. If the cancer be situated towards the sternal or under aspect, however isolated it may appear, it will be found that the mammary gland will certainly have become infiltrated, lying as it does between the morbid mass and the lymphatics. When, however, the tumour is seated at the upper or outer border of the gland; when it appears to be detached from the breast, lying rather in the axilla or below the clavicle than in connection with the gland; when the breast itself is very large and fat, but healthy to the feel, without hardness or retraction of the nipple; when there is no sign whatever of deep infiltration of the breast—it may then be a question whether it will not be more prudent to extirpate the tumour alone, with the adipose bed in which it lies, and a deep slice of the adjoining mammary gland, than to perform the more serious operation of removing the whole of the breast. In determining this point we must, I think, be guided by the situation of the tumour, the feel of the breast, and the size of that organ. If the tumour be distinctly axillary, if the breast feel perfectly soft and healthy, with the nipple projecting, there is no reason to fear infiltration by cancer of the central and sternal portions of the mammary gland. I have found on careful microscopical examination of breasts removed for scirrhus at the axillary border, that the above-named parts of the gland were entirely free from all sign of disease. If the mamma be small and shrunken, the whole may be removed without any increase of danger ; if it be very large, the Surgeon best consults the patient's safety by simply removing the tumour with a deep triangular slice of the contiguous portion of the gland ; but if there be any hardness or suspicious nodulated feel about the mammary gland, if the line of demarcation between it and the tumour be not defined, and particularly if the patient be thin, so that the operation is not a very severe one, the extirpation of the whole of the breast ought certainly to be practised. However widely the parts are removed, the line of incision usually comes together readily and evenly, owing to the laxity of the integuments in the mammary region.

I have observed in those cases in which it becomes necessary to extirpate tumours of the mammary region, without removal of the gland, that erysipelas has more frequently followed the operation than when the gland, being affected, has required removal.

**Return of Cancer after Operation** may take place in three situations :- in the cicatrix of the part operated upon ; in the neighbouring lymphatic glands ; or in some internal organ. When cancer recurs in the neighbourhood of the previously affected part, it is probably owing to the cancer-cells having diffused themselves so widely into the skin, the subcutaneous areolar tissue and muscles, or neighbouring lymphatic glands, and after the removal of the tumour these cells become the germs of new growths. In these circumstances it may recur in the cicatrix and then implicate the glands ; or in the glands without the cicatrix having been previously affected. In local relapse of this kind, it often happens that the disease, so reproduced, runs its course more rapidly than if no operation had been performed ; the increased action set up in the part during the healing process appearing to give augmented force to the reproductive energy of the cancerous growth. In some cases it even returns in the wound before cicatrisation is completed, the ulcerated surface then assuming the ordinary character of the cancerous ulcer. In other cases, the cicatrix, some weeks or months after it is fully formed, assumes a dusky red or purplish tinge, becoming hard, stony and nodulated at points ; these nodules being round or oval, often very numerous, and varying in size from a pin's head to a pigeon's egg, studding the whole length and breadth of the cicatrix, and at last running into true cancerous ulceration. In such circumstances, the only hope of prolonging the patient's life lies in the speedy excision of the whole of the diseased structures, or their extirpation by caustics, provided there be no deep affection of the glands, nor evidence of internal secondary deposit. But if the axillary glands be much enlarged, either alone or together with recurrent disease in the cicatrix, or if there be any sign of internal cancer, further operation will be improper.

AMPUTATION OF THE BREAST.—The question of amputation of the breast should always be raised and discussed with more than ordinary regard to the feelings of the patient. A woman looks upon her breast as alike the emblem and the ornament of her womanhood. She shrinks from the idea of its being affected by disease. She suffers acutely in mind when it is invaded by tumour of any kind : the horrid dread of that disease being cancer ever haunts her thoughts, not so much from the fear of the possibly impending operation, but rather from the distress of mind, in many cases amounting to a sense of humiliation, at the idea of the mutilation of which she is about to become the victim. The operation for the removal of a breast, whether affected with cancer or with other disease, may be performed in the following way. The patient should lie upon a table, with the arm hanging over the side, tied down or held by an assistant. If the tumour be large, and the loss of blood a matter of much consequence, another assistant should compress the subclavian artery on the first rib. The hæmorrhage will, however, depend more on the nature than on the size of the tumour. In all cancerous tumours, but especially in the encephaloid, it is considerable, and from many enlarged vessels. In simple tumours, even of very large size, it is often trivial. I have removed a simple tumour of the breast of many pounds weight, and only had to tie one spouting vessel. Indeed, nothing indicates more conclusively the enormous vegetative activity of cancerous tumours, and the great drain they must exercise upon the system generally, than the large size and great number of their supplying arteries, compared with those sent to a simple tumour many times larger than the malignant one. If the veins about the part be much dilated, measures should be taken to arrest the flow of blood from them, as it may sometimes be dangerously profuse; indeed, South relates the case of a patient who died from this cause during the operation.

In amputations of the breast for malignant disease, there are three principal and vital points that must be attended to: 1. Always to remove the whole of the breast-gland; 2. Always to remove the nipple; 3. Always to remove widely all dimpled skin.

The direction of the incision through the integuments is varied by different Surgeons; some prefer a transverse, others a perpendicular one. I think that no definite plan should be followed, but the direction of the cut made to vary according to the situation and size of the tumour, and the amount of integument that requires removal. In all cases, the nipple should be included. In ordinary cases, as a general rule, I prefer an oblique incision following the course of the fibres of the great pectoral muscle; as it enables the Surgeon, if necessary, to extend the cut into the axilla for the removal of enlarged glands, and, after cicatrisation, allows the movements of the arm without undue traction. An oblique elliptical incision, of sufficient length, may thus be made, first below, and next above the nipple, so as to include a sufficient quantity of integument (Fig. 666). In some cases, where the skin is somewhat involved, a transverse incision may be made in addition to this, so as to include the affected integument in a triangular manner. When the tumour is very large and prominent, a double vertical incision may very conveniently include the nipple and the most suspicious parts of the skin. The dissection should then be rapidly carried down, by a few strokes of the scalpel, to the pectoral muscle, and the breast removed from the cellular bed in which it lies. When the tumour is of large size, and especially if it be of simple character, this part of the operation may be done very expeditiously by drawing down the mass and touching the areolar tissue with the scalpel, when the whole tumour will peel off the pectoral muscle, and can readily be detached. After the removal of the diseased breast, it and the tumour, as well as the whole interior of the wound, must be carefully examined, in order to ascertain that no slices of morbid tissue have been left behind; if so, they must be freely cut out; and if, as sometimes happens, the growth be rather firmly adherent to the pectoral muscle or subjacent structures, portions of these must also be removed. Should it be found that there are any enlarged glands in the axilla, they may be extirpated either by extending the wound upwards in this region, or by making a separate incision into the axilla, and carefully dissecting them out. In doing this, the edges and point of the scalpel should be very carefully used, and the glands rather teased out by the handle of the knife and the fingers, so as to avoid the risk of hæmorrhage, which is apt to be troublesome in this situation. The extirpation of enlarged axillary glands is the most difficult part of operations on the breast, as they often extend much higher into the axilla and under the edge of the pectoral muscle than would at first appear. When exposed, they may be seized with a double-hook or an artery-forceps, well drawn down, and then enucleated as far as practicable with the fingers, aided by a few cautious touches with the edge of the knife. The less the point is used deep in the axilla, the better for the patient. Should the glandular mass extend high up, coming into close relation with the axillary vessels, it would be prudent not to attempt its complete extirpation with the knife; but, having been separated, as far as practicable in the way already mentioned, it should be well drawn down, and then tightly tied as high as possible with a piece of whipcord, all that portion below the noose being then cut off. In this way we may avoid the two great dangers which attend extirpation of tumours in this locality, deeply situated and out of sight—hæmorrhage, and

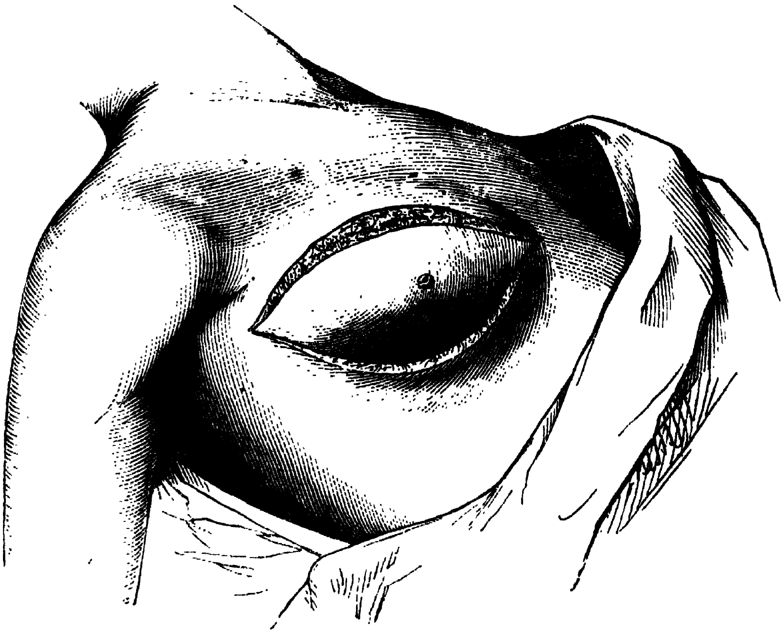

Fig. 666.—Incisions for Removal of Cancer of Breast.

the entry of air into dilated veins; and, the ligature being applied beyond the diseased mass, that which remains of it will slough away when the thread separates.

Tumours are occasionally met with in the axilla as a primary disease, unconnected with any malignant or other morbid action either in the upper extremity or in the breast. Such masses may be either lymphadenomata or cancers; and may require extirpation. When the former, they are readily enough enucleated; but when cancerous, they become so widely and deeply adherent, that their removal cannot be undertaken without much danger. In such dissections, I have had occasion to expose the axillary and subscapular vessels to some extent.

The *after-dressing* of the wound is of great consequence. A wound that gapes immensely whilst the arm hangs down, will be found to close with the greatest ease when the arm is raised and laid across the chest. All bleeding vessels, then, having been secured, the edges of the wound must be brought into apposition by attention to position of the arm. Should there be a tendency to gape, or should any transverse cut have been required, the edges may be brought together by a few points of suture. But if the integuments have not been freely removed, if the parts come well together, it is far better to dispense entirely with sutures, and to retain the edges in contact with long narrow strips of plaster. The edges of the wound are supported and compressed slightly by pads of lint. The wound itself is covered by a piece of antiseptic lint and the arm supported in a sling. No bandage of any kind is necessary: indeed, I look upon body-bandages in these cases as injurious. They prevent free respiration by their tightness, and favour hæmorrhage by their warmth. The wound must be dressed on ordinary surgical principles. In many cases it will unite by the first intention; for owing to the yielding nature of the parts in this situation, the lips of the cut come into very good apposition, even though a considerable mass has been removed. By some it has been supposed that relapse of cancer is less liable to take place if the wound unite by granulation, than if it come together by more speedy union; of this, however, there is at present no proof with which I am acquainted, though it is by no means improbable that the suppurative action may eliminate cancer-cells from the neighbouring tissues.

The *mortality from amputation of the breast* is not considerable, barely amounting to 10 per cent. The circumstances that chiefly influence it are the nature of the tumour, the size of the breast, and the extent of the incision into the axilla. The operation is much more dangerous when performed for the removal of cancerous than of simple tumours: and the danger increases in proportion to the length of time the cancer has been allowed to exist before the operation is undertaken. In proportion as the patient's general health has become undermined by the continuance of the malignant disease, so the tendency to pyæmia and erysipelas increases. Women who have small mammæ, with little fat, bear the operation best. The danger of the operation is, for obvious reasons, much greater in women with large breasts, in whom the areolar tissue is loaded with coarse yellow fat. In these, reparative action is slow, and there is much tendency to sloughing and to erysipelas. Lastly, the operation becomes dangerous in proportion as the tumour is adherent to the pectoral muscle, and the dissection requires to be carried deeply into the axilla or under the pectoral. The danger here is threefold: 1, from hæmorrhage; 2, from the entry of air into a vein; 3, and chiefly, from opening up the deep fascia of the axilla, and the risk of the occurrence of deep cellulitis. When death follows these operations, it is usually the result of erysipelas or of pyæmia.

There are two dangers which attend excision of the breast rather more frequently than other operations; viz., 1st, a congestive or low form of pneumonia, not dependent on any blood-poisoning, but arising from defective aëration occasioned by the breathing being shallow and restrained either by tight bandaging of the chest, or by the pain induced by the movement of the chest-walls in respiration; and 2nd, embolism of the pulmonary artery. I have known several instances of death from each of these causes. The first danger can obviously be guarded against; the second cannot.

The **Male Breast**, though very rarely the seat of disease, may occasionally become affected in a somewhat similar manner to the mammary gland in the female; being, in some instances, *hypertrophied*, in others the seat of an *abnormal secretion of milk*, and, in other cases, affected by the formation of *cystic*, *sarcomatous*, and *scirrhous tumours*. These growths require removal by the same kind of operative procedure that is adopted when they affect the female breast, though of a less extensive character.

**Axillo-mammary Cancer** presents some peculiarities that deserve special consideration. It developes at the outer and upper angle of the mammary gland towards its free border, so that, instead of growing into its substance and remaining imbedded in it, it tends to push into the direction of least resistance to its out-growth, and thus to extend into the areolar space at the lower border of the axillary edge of the pectoralis major, and lie between it and the latissimus dorsi muscle. The tumour feels hard, nodulated, and is rounded in shape. Sometimes it appears to be scarcely attached to the mammary gland. But on closer manipulation it will be found to extend deeply into its substance, which towards the base of the tumour feels hard and thickened. The greater portion of the gland, the median half and much of the lower part, will continue long unaffected by cancerous infiltration. The nipple is not retracted until a very late period in this form of the disease. It and the areola continue to preserve their normal appearances, long after the skin above them has become involved and the axillary glands enlarged. The manner in which the skin is implicated and the appearance it presents is peculiar and characteristic. It becomes involved early by dimpling from below in a transverse direction at the upper and outer border of the mamma, where there is a tendency naturally to a fold or crease in the integument. There the skin becomes infiltrated in a transverse line of hard scirrhus, red, depressed and puckered in, with much feeling of constriction and difficulty in raising the arm from the side. The disease, when once it has reached this stage, will of course make rapid progress both locally and constitutionally.

That these axillo-mammary cancers commence in the breast-gland there can be no doubt, although their rapid development beyond its limits may, at first, lead to the suspicion that they have commenced outside it.

It is only towards the upper and outer border of the mamma that these outgrowing cancers seem to develop themselves. I have never seen them at the inner or lower part of the gland, unless the whole of its structure had been previously infiltrated. The operation in these cases should be complete and thorough, the whole organ being removed, however healthy the nipple, areola, and some portions of its gland-structure may appear to be. The skin should also be widely removed where implicated, and the dissection carried as high into the axilla as safety will permit. Unless thorough extirpation be practised, speedy and rapid recurrence will ensue. In this as in all operations for diffused cancer, the wound should be well washed out with a solution of chloride of zinc (1 to 20), so as to destroy scattered and wandering cells.

## AXILLARY TUMOURS.

SCIRRHOUS TUMOURS may form in men as well as in women, as primary disease, under the pectoral muscle or in the axilla (Fig. 667). Such tumours might, in their early stages, be dissected out; but if they extend high up to the clavicle, or implicate the skin widely by infiltration, they should, I think, be left, as was necessary in the patient from whom Fig. 668 was taken, where the size of the tumour and its connections precluded the possibility of operation. Their removal cannot, indeed, at any stage, be undertaken without much danger. In dissections requisite for the extirpation of such masses, as in Fig. 667, I have had to expose the axillary and subscapular vessels and their accompanying nerves. The cancerous growth being usually somewhat widely disseminated, it is difficult to be certain that the whole is fairly extirpated: hence, recurrence is likely speedily to take place.

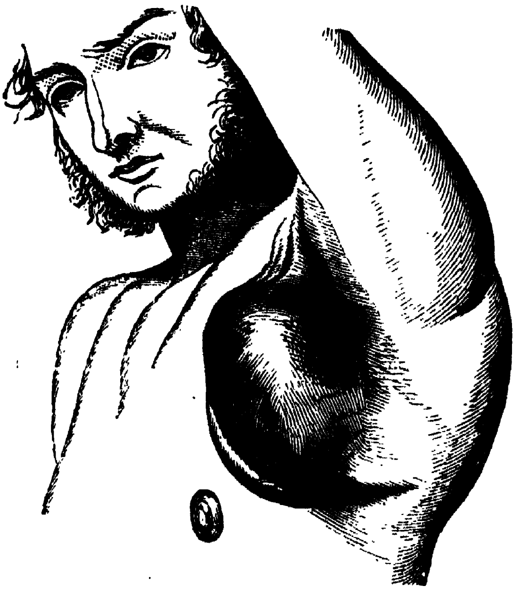
Fig. 667.—Scirrhous Tumour in Axilla of a Man.

CHRONIC STRUMOUS DISEASE of the axillary glands is occasionally met with, forming a large lobed mass under the pectoral muscle. Such a tumour as this may easily and safely be enucleated, and should be removed if it have resisted all ordinary topical and constitutional treatment. It will be found to be infiltrated with tubercle.

SIMPLE TUMOURS of various kinds are met with in the axilla. The most common are lymphadenomata of the axillary glands, fatty, and fibro-cellular tumours.

**Lymphadenoma of the Axillary Glands** is chiefly met with in young women, forming a smooth, lobed, movable mass, usually about the size of an orange, in this situation. If left untouched, a process of plastic deposit goes on in the tumour until at last it may attain a great bulk.

These tumours may readily be removed by enucleation.

The **Fibro-cellular Tumour** will sometimes attain a great magnitude in the axilla, forming a large, smooth, rounded mass, stretching the muscles and displacing the vessels and nerves, as in Figs. 669 and 670. In this case the tumour, which was of very slow growth, developed between the serratus and the ribs, stretching the muscle over it so as to form a species of capsule to it, drawing the scapula forwards, depressing the chest-wall, and drawing the axillary vessels down to about three inches below the clavicle. In removing it I was obliged to take away a piece of the expanded serratus as large as the hand. The patient made an excellent recovery, and experienced no difficulty in breathing afterwards.

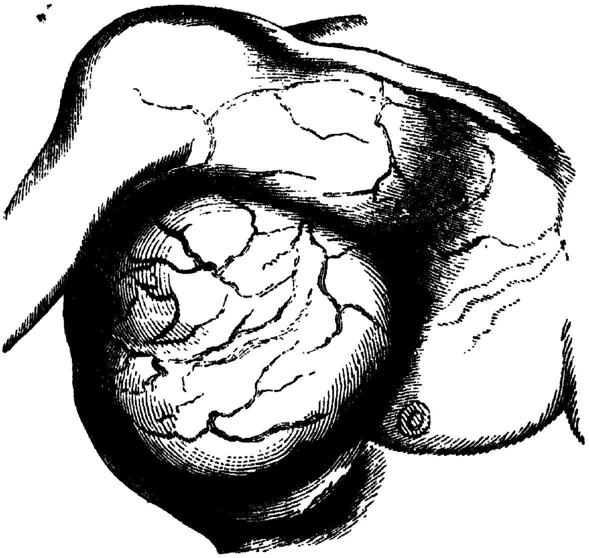

Fig. 668.—Primary Cancer in Axilla in a Man.

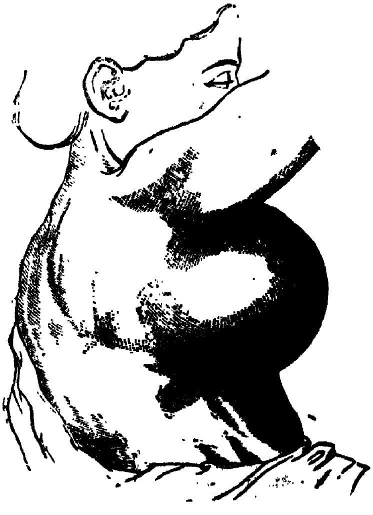

Fig. 669.—Fibro-cellular Tumour in Axilla of a Woman.

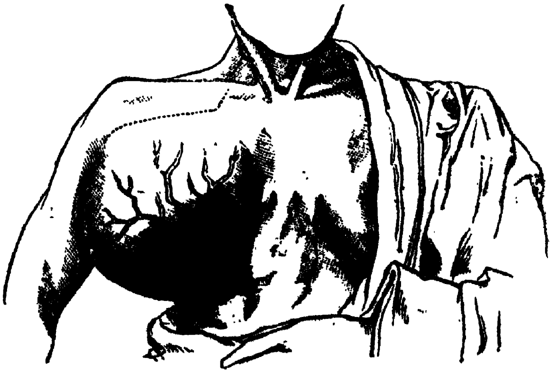

Fig. 670.—Same Tumour, Front View.

# DISEASES OF THE ABDOMEN.

## CHAPTER LXII.

### HERNIA.

By **Hernia**, in its widest sense, is meant the displacement of an organ from the cavity in which it is naturally contained, by being protruded through an abnormal or accidental opening in its walls; when, however, it escapes through one of the natural outlets of the part, it is not considered hernial. Thus, the protrusion of the brain through an aperture in the cranium, or of the lung through one in the thoracic walls, or of a portion of intestine through the abdominal parietes, is termed a hernia of the organ; but the descent of the bowel through the anus does not come under this designation. Here, however, we have only to consider the hernial protrusions that occur from the abdomen—the common situation of this disease.

A hernia may occur at almost any part of the abdominal wall; though it is far more liable to do so in some situations than in others, being commonly met with at those points where the muscular and tendinous structures are weakened to allow the passage of the spermatic cord in the male, and of the round ligament in the female; or for the transmission of the large vessels to the lower extremity; hence the inguinal and crural canals are the common situations of this disease. It may, however, occur in various other situations, as at the umbilicus, the thyroid foramen, the sciatic notch, in the vagina, the perinæum, through the muscular portions of the abdominal wall, the diaphragm, &c.

Structure of a Hernia.—In whatever situation it occurs, a hernia is composed of a **Sac** and its **Contents**.

The **Sac** is the prolongation of that portion of the peritoneum which overlies and corresponds to the aperture through which the hernia protrudes. It is in all cases composed of a *neck* and a *body*.

The **Neck** is usually narrowed, though in some old herniæ it becomes wide and expanded; it is commonly short, consisting indeed of a sudden constriction of the sac in this situation, as happens in many forms of femoral hernia; but in other cases it is elongated, narrowed, and thickened, and even vascular in structure. The neck of the hernial sac usually becomes greatly thickened and of an opaque colour, by the deposit of plastic matter in or upon it from the irritation to which it has been subjected by the pressure of the hernial tumour or the truss, by the incorporation of the subserous areolar tissue lying externally to it, or by the puckering together of its folds, which have been compressed by the aperture in which it lies.

The **Body** of the sac is usually globular or pyriform, sometimes elongated and cylindrical; it may vary from the size of a cherry to a tumour as large as the head. When recent, it is usually thin and transparent, though in some cases it becomes greatly thickened, having arborescent vessels ramifying in it, and being almost laminated in structure; this is especially the case in old femoral herniæ. In other instances, however, it becomes thinned and atrophied as the tumour expands, so that the contents become visible through it. This is especially the case in old umbilical herniæ, in which I have seen it as thin as the finest gold-beater's skin. In some cases the hernial sac undergoes degeneration, becoming converted into a fibrous or even calcareous layer.

The sac, though usually forming a perfect inclosure to the hernial contents, occasionally constitutes but a partial investment to them, more particularly in such organs as the cæcum or bladder, which are naturally partially uncovered by peritoneum. In other instances it may be ruptured, or altogether absent. The sac is absent when the hernia occurs as the result of a wound, injury, or abscess of the abnormal wall. It cannot be said to exist in a congenital hernia, and may be absent in cæcal and in umbilical herniæ. More rarely a double hernial sac is met with, one being protruded into or placed behind the other. There are instances of three sacs occurring together; and Sir A. Cooper relates a case in which six were met with in the same person.

The abdominal parietes outside the sac undergo important changes. The aperture through which the hernia protrudes usually becomes circular; after a time, indurated and rounded at the edge, and considerably enlarged; when situated in the movable portions of the abdominal wall, as in the inguinal region, it becomes displaced in old herniæ, being dragged down by the weight of the protrusion, usually towards the mesial line. The subserous areolar tissue always becomes greatly thickened, often indurated and fatty, so as to constitute one of the densest investments of the sac, and, in some old cases of hernia, closely to resemble omentum. The more superficial structures, such as the integument and fascia, are much elongated and stretched; often tense, but not unfrequently hanging in folds; they are usually thinned, but, if a truss have been long worn, they become thickened and condensed by the pressure of the pad.

**Contents.**—The contents of the sac vary greatly; every viscus except the pancreas having been found in hernial tumours. Most frequently a portion of the *Small Intestine*, more particularly of the ileum, is protruded, constituting the form of hernia called **Enterocele.** The quantity of intestine within the sac may vary from a small section of the calibre of the gut, the whole diameter not being included, to a coil several feet in length, with its attached mesentery. After a portion of the intestine has once descended, the protruded part tends to increase in quantity; until, as in some large and old herniæ, the greater portion has been known to lie in the sac. The *Large Intestine* is rarely found in a hernia, though the cæcum is occasionally met with. When intestine has been long protruded, it usually becomes thickened in its coats, and narrowed, greyish on the surface, and more or less deranged in its functions. The corresponding mesentery becomes thickened, hypertrophied, and vascular.

*Omentum* is often found in hernial sacs, together with intestine; but is not unfrequently met with alone, constituting **Epiplocele.** After having been protruded for some time it becomes thickened, brawny, and laminated, losing its ordinary cellulo-adipose texture, and becoming indurated. Its veins usually assume a somewhat varicose condition; and the mass of omentum becomes triangular, the apex being upwards at the abdominal aperture, and the base below, broad and expanded. In some cases it can be unfolded; in others, it is matted together into a cylindrical mass. Occasionally apertures form in it, through which a coil of intestine may protrude, thus becoming secondarily strangulated within the sac. In other instances, cysts are met with in it containing fluid, or into which the intestine may even slip. When intestine and omentum together are found in a hernia, the disease is termed an **Entero-epiplocele**; and in these circumstances the omentum usually descends before and occasionally envelopes the intestine. Besides these, the ordinary contents of herniæ, the stomach, liver, spleen, sigmoid flexure of the colon, bladder, uterus, and ovaries, have all been found in them. In a case described by Scanzoni, the gravid uterus and ovaries were enclosed in the sac of an inguinal hernia.

*Adhesions* commonly form within the sac in old-standing cases. These may take place between the contained viscera merely, as between two coils of intestine, or between these and the omentum; or they may form between the wall of the sac and its contents, either by broad bands, or else by bridging across from one side to the other, and inclosing a portion of the viscera. In recent cases these adhesions are soft, and may readily be broken down; but when of longer duration, they are often very dense, and are especially firm about the neck of the sac.

Besides the viscera, the hernial sac always contains a certain quantity of *fluid* secreted by and lubricating its interior. In most cases, this is in but small quantity; but in some instances, when the sac is inflamed, or the hernia strangulated, a very considerable bulk of liquid has been met with; I have seen as much as a pint escape from a large hernia in an old man. When abundant, it is generally of a brownish colour, though clear and transparent; it is met with in largest quantities in inguinal hernia.

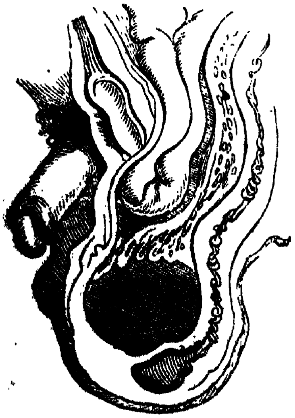

Fig. 671.—Hydrocele of Hernial Sac.

**Hydrocele of the Hernial Sac.**—In some instances the fluid becomes collected in a kind of cyst within the sac, formed by the omentum contracting adhesions to its upper part, and leaving space below for the fluid to collect, in which this accumulates between the omentum above and the wall of the sac below; this condition, represented in the annexed drawing (Fig. 671), has been called *Hydrocele of the Hernial Sac*, and constitutes a somewhat rare form of disease. The fluid is often in considerable quantity; in a case which I tapped some years ago, nearly three pints of dark-brown liquid had thus accumulated, and were drawn off.

If we limit the term *hydrocele of the hernial sac* to those cases in which there is a slow and gradual accumulation of fluid at the bottom of an old hernial sac, which has been cut off from all communication with the peritoneum either by the radical cure of the hernia, or by the adhesion of intestine or omentum to the upper part and neck of the sac, it must be considered a rare disease; and but few cases are recorded by surgical writers. Curling, in his work on the *Testis*, states that, during his connection with the London Hospital, he saw only one case; and the only others with which I am acquainted, besides one that occurred in my own practice, are two related by Pott, two by Pelletan, one by Boyer, and one by Lawrence. This disease must not be confounded with the accumulation of fluid, in whatever quantity, in strangulated hernia, or in hernial sacs that communicate with the peritoneal cavity. Its distinguishing feature is the accumulation of fluid in a sac that has been cut off from all communication with the cavity of the peritoneum.

**An Accumulation of Ascitic Fluid in a Hernial Sac** may occur when hernia is complicated with dropsy of the peritoneum. In one case of this kind which occurred in my practice at University College Hospital, the hernia, which was femoral, in a woman, was very tightly strangulated, as large as a shaddock, very tense, with distinct fluctuation; the skin covering it being much stretched, this was peculiarly evident. On opening the sac, fluid followed in a jet, as if a hydrocele had been punctured, and about four inches of strangled gut were found lying at the bottom of the sac. After dividing the stricture, serous fluid in large quantity continued to drain from the peritoneal cavity for several hours after the operation.

**Loose Foreign Bodies** have occasionally been met with inside hernial sacs. They are usually rounded, smooth, and firm; vary in size from a pea to a chestnut; and are mostly single. On section, they are found to consist of a fatty central nucleus with a laminated fibrous envelope, usually of considerable thickness. They are apparently composed of one of the glandulæ epiploicæ, which has become detached, fallen loose into the peritoneal cavity, and become enveloped in plastic layers.

SIGNS.—The signs of hernia, though varying considerably according to the contents of the sac and the condition in which it is placed, present in all cases many points in common. There is an elongated or rounded tumour at one of the usual abdominal apertures, broader below than above, where it is often narrowed into a kind of neck; usually increasing in size when the patient stands, holds his breath, coughs, or makes much muscular exertion. It can be pushed back into the abdomen on pressure, or goes back readily if the patient lie down, but reappears when he stands up. On coughing, a strong and distinct impulse may be felt in it.

When the hernia is altogether **Intestinal**, it is usually smooth, gurgling when pressed upon, sometimes tympanitic and rumbling, and resonant on percussion. It may be returned into the cavity of the abdomen with a distinct slip and gurgle; it has a well-marked impulse on coughing, and is usually accompanied by various dyspeptic symptoms, and often with much dragging uneasiness. **Omental Hernia** is usually soft and doughy, returning slowly on pressure into the abdomen, feeling irregular on the surface, and having an ill-defined outline. It occurs most frequently on the left side, and is rare in infants, in whom the omentum is short. In **Entero-epiplocele** there is a combination of the two conditions and their signs; but these are usually so uncertain, that few

Surgeons care to predict before opening the sac what the probable nature of the contents may be.

**Cæcal Hernia** necessarily occurs on the right side only. It is a large, knobby, and irregular tumour, irreducible, owing to the adhesions contracted by that portion of cæcum which is uncovered by peritoneum. The peculiarity of this hernia consists in the sac being absent, or only partial in the majority of cases, the peritoneum being stripped off as the gut descends. When this hernia is large, and partially invested by serous membrane, a sac usually exists at its upper aspect, into which a portion of small intestine may fall, and which may in some cases constitute a second hernia lying above or before the cæcal one, which will be found situated at the posterior wall when this hernial pouch is opened. Occasionally the vermiform appendix and the caput coli are found in the sac, but can rarely be returned. The rule of cæcal hernia having a partial peritoneal investment only, does not hold good in all cases; and instances have occasionally been met with in which this portion of intestine lay in a distinct sac.

**Hernia of the Bladder or Cystocele** is very rare; and, like that of the cæcum, is usually enclosed in a partial peritoneal investment, though it is not necessarily so. South states that there is a preparation at St. Thomas's Hospital, in which the fundus of the bladder, with its peritoneal covering, has passed into a distinct sac. In some instances the cystocele is accompanied by an enterocele. This hernia is always irreducible, is attended by a good deal of difficulty in urinating, with varying tension, according to the quantity of fluid contained; by squeezing it, urine may be forced out through the urethra, and fluctuation has been felt in it. Urinary calculi have been formed in the tumour, and have been removed by incision through the scrotum, or have ulcerated out.

CAUSES.—The causes of hernia are usually sufficiently well marked. In some instances the disease is *congenital*, arising from preternatural patency of the abdominal apertures; in other cases, it occurs at a later period of life, in consequence of some *forcible effort*, as lifting a heavy weight, jumping, coughing, straining at stool, or passing urine through a tight stricture. Such causes as these act especially in tall and delicate people, particularly in those who have a natural disposition to weakness or bulging of the groins. The displacement of the abdominal viscera by a *gravid uterus*, will also occasionally give rise to the disease. Hernia is especially liable to be produced by a combination of causes: thus, if an aged person, one with a feeble organisation, or whose abdominal apertures have been patent in consequence of rather sudden emaciation, make a violent effort, a hernial protrusion is very apt to occur.

Amongst the most frequent **Predisposing Causes** of hernia, are certainly sex, age, and occupation.

**Sex.**—Men are more liable to this disease than women, in the proportion of about 4 or 5 to 1. Thus, according to Malgaigne, in France, one man in thirteen and one woman in fifty-two are the subjects of hernia. But, though men are more generally liable to hernia than women, they are less so to certain forms of the disease, especially to the femoral and umbilical. It is to the inguinal that they are particularly subject. According to Lawrence, out of 83,584 patients who applied to the City of London Truss Society, 67,798 were males and 15,786 females. Of 43,214 applicants at the same institution during the eight years 1860-1867, 36,161 were males and 7,053 females. Of these, 34,788 males and 3,085 females had inguinal hernia; 1,373 males and 3,968 females had femoral hernia.

**Age** exercises a very material influence upon the frequency of hernia. Malgaigne, who has carefully investigated this subject, finds that in infancy the disease is sufficiently common, owing to the prevalence of congenital hernia at this period of life ; and, that in the first year after birth hernia occurs in the proportion of 1 in every 21 children. It then goes on decreasing in frequency, there being 1 in 29 at the second year; 1 in 37 at the third year; until, at the thirteenth year, it has fallen to 1 in 77. Shortly after this, its frequency begins to rise again, and then goes on progressively increasing until the close of life ; thus, at the 21st year, there is one case in 32 ; at the 28th year, 1 in 21; at the 35th, one in 17 ; at the 40th, 1 in 9 ; at 50, 1 in 6 ; from 60 to 70, 1 in 4 ; and from 70 to 75, 1 in 3. In women, according to Malgaigne, hernia most frequently occurs from the 20th to the 50th years.* Malgaigne's figures give the ages of the patients when they came under his observation. Kingdon has investigated the question of the ages at which the hernia commenced. He states that out of 9,296 cases, 5,659, or 60.8 per cent., had commenced before 35, and 3,637, or 39.2 per cent., after that age.

The tendency to hernia is often hereditary, and congenital hernia is common in the children of hernial parents.

Some races of men are less subject to hernia than others. Thus it is less frequent in the negro than in the white man, except in the ventral form.

**Occupation.**—Those occupations in which the individual is exposed to violent muscular efforts, more particularly of an intermitting character, predispose strongly to the occurrence of hernia ; and in these employments the tendency to the disease is often greatly increased by the injurious habit of wearing tight girths or belts round the waist, which, by constricting the abdomen, throw the whole pressure of the abdominal contents upon the inguinal regions.

CONDITIONS PRESENTED BY HERNIA.—The conditions in which a hernia may be found are very various, and entail corresponding differences in the result and treatment of the affection. When first formed, most herniæ may be said to be *Incomplete*, being for a time retained within the orifice of the canal through which they eventually protrude. When they have passed altogether beyond the abdominal walls, they are said to be *Complete*; and this is the condition in which they are usually presented to the Surgeon. A hernia may also be *Reducible*, *Irreducible*, or *Strangulated*.

## REDUCIBLE HERNIA.

A hernia is commonly at first *Reducible*; that is to say, it may readily be pushed back into the cavity of the abdomen, protruding again when the patient stands up, holds his breath, or makes any exertion, and having a distinct and forcible impulse on coughing. Though the hernia contents, in these cases, are reducible into the abdomen, the sac is not; it almost immediately contracts adhesions to the areolar tissue, by which it is firmly fixed in its new situation; though in some cases, as we shall hereafter see, it may be pushed back.

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* Those interested in the statistics of Hernia will find much information in an elaborate article by A. Wernher, of Giessen, in Vol. XI. of Langenbeck's "Archiv für Klinische Chirurgie" (1869), and in "Reports of Provost-Marshal General's Bureau, United States Army, 1876."

APPLICATION OF TRUSS.—In the Treatment of a reducible hernia, our object is, by the application of a proper truss, to retain the protrusion within the cavity of the abdomen. In order to do this, the patient must be provided with a proper kind of truss, adapted to the particular nature of the hernia. In umbilical and ventral ruptures, an elastic pad and belt may most conveniently be used. In selecting the truss, care should be taken that the spring be of proper strength, adapted to the size and power of the individual; and that it be properly shaped, so that it does not touch any part of the abdominal wall, but merely bears upon the points of pressure and counter-pressure. The pad should be convex, and firmly stuffed, and of sufficient size to press not only upon the external aperture, but upon the whole length of the canal. Before applying the truss, the hernia must be reduced, by placing the patient in the recumbent position, relaxing the muscles by bending the thigh upon the abdomen, and pressing the tumour back in the proper direction; the truss should then be put on, and be worn during the whole of the day; indeed, the patient should never be allowed to stand without wearing it. At night, it may either be left off altogether, or a lighter one applied. In some cases, the skin becomes irritated by the pressure of the pad; in these circumstances, an elastic air-cushion may be used, or the parts subjected to pressure may be well washed with spirit-lotion. The truss may be known to fit by testing it in the following way. The patient should be made to sit down on the edge of a chair, and then, extending his legs, opening them widely, and bending the body forwards, cough several times. If the hernia do not now slip down behind the pad, we may be sure that the truss is efficient, and will keep the rupture up in all ordinary circumstances.

RADICAL CURE OF HERNIA.—Various means have been devised in order to effect the radical cure of a reducible hernia. The only plan that is at the same time perfectly safe and permanently successful, is the compression of a well-made truss. In this way, not unfrequently, the herniæ of infants become radically cured; the same result, however, seldom occurs at a more advanced period of life. In order that compression may succeed in this way, it is necessary that it should not only be applied to the external aperture through which the rupture escapes, but to the whole of the canal. It must also be continued for a very considerable time, at least a year or two, and care should be taken that during the treatment the rupture is not allowed to descend; every time it comes down, any good that may have been derived is necessarily done away with, and the treatment has to begin, as it were, anew. Radical cure of a hernia by truss-pressure can only be effected in those cases in which the abdominal aperture has been left congenitally weak or open. Hence it is only to be hoped for in children and very young adults, and only in those two congenital forms of hernia—the umbilical and the inguinal. The continued pressure of the truss-pad in these cases seems to determine those adhesive processes which are necessary for the closure of one of the abdominal apertures. After the cure is supposed to have been effected in this way, the application of the truss must be continued for a very considerable length of time, lest by any unfortunate movement the rupture descend again.

The **Operations** that have been devised for the radical cure of hernia are all founded on one of two principles ; viz., the excitation of such an amount of peritonitis in the sac, or its neck, as to ~~cure~~ its obliteration ; or the plugging of the hernial aperture by invagination of the integumental tissues.

If the accomplishment of these conditions would always prevent the recurrence of the rupture, the radical cure might frequently be undertaken. But it is impossible to look upon the agglutination of the walls of the sac, or the closure of the abdominal aperture, as the sole conditions required. To accomplish the radical cure, it would be necessary in many cases to effect changes in the shape and connections of the abdominal contents, to alter the size of the abdominal cavity, and indeed to modify in various ways many conditions independent of those immediately connected with the hernial protrusion. Many of the means of radical cure, by which obliteration of the interior of the sac or of its neck is sought to be effected by the application of sutures or ligatures, by the introduction of caustics, by excision, scarification, puncture, or injection with tincture of iodine, are attended with so much danger from peritonitis, and are so seldom followed by any good results, that their consideration need not detain us here, the more so as they are universally abandoned by Surgeons of the present day.

The operations that are now practised for the radical cure of hernia are conducted on two principal plans, however much they may be varied in their details by the ingenuity of particular Surgeons.

The first method of treatment consists of invaginating simply a portion of the scrotum, and fixing it in the inguinal canal, where it becomes adherent, and so occludes the aperture of exit. Of this kind of operation, Wutzer's is the best example. The second method of treatment consists in excising a portion of the integumental structures, and then by means of sutures attaching these and the deeper parts together, and thus leading to the consolidation of the canal. Of this, Wood's operation is the best example. The following are the details of these procedures.

**Wutzer's Operation.**—The late C. W. Wutzer, of Bonn, adopted a plan of radically curing reducible inguinal herniæ, combining the two principles on which the older operations were founded, viz., the agglutination of the neck of the hernial sac by the excitation of inflammation in it, and the closure of the inguinal canal by the invagination of the scrotum ; and he carried out these objects in a safer and more successful manner than by any of the methods previously employed. His plan of treatment consists in introducing a plug of the scrotum into the inguinal canal, and fixing it there by exciting adhesive inflammation in the neck of the sac. The details of the operation are as follows. The patient lying on his back, and the hernia being reduced, the Surgeon pushes his index-finger up the inguinal canal as high as the internal ring, carrying before it a cone of the scrotal tissues ; a box-wood hollow cylinder, about four inches long (Fig. 672, C), well oiled, is then pushed up as the finger is withdrawn, so as to occupy its place in the inguinal canal. Along the interior of this cylinder a flexible steel needle, gilt (A), fixed in a movable handle, is then pushed, so as to traverse the invaginated scrotum, the hernial sac, and the anterior abdominal wall, through which its point is caused to protrude. A concave boxwood case (B) is then passed over the projecting point of the needle, and fixed by the other end by a screw apparatus to the cylinder (C), so as to compress the inclosed tissues. The apparatus so fixed is left *in situ* for six or eight days; when, some discharge being established, it is withdrawn, and

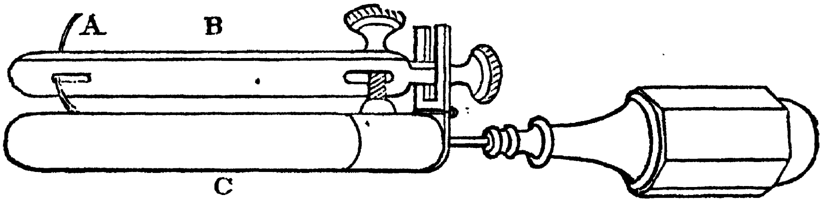


Fig. 672.—Wutzer's Apparatus for Radical Cure of Hernia.

the invaginated scrotal plug supported by lint introduced up its interior, and by a spica bandage tightly applied. The patient is kept quiet for a fortnight longer, when he is allowed to move about, wearing a light truss for three or four months.

This method of treatment is easy of execution, and appears to be more successful than any that have preceded it. Yet it is open to the objections that attend all plans for the radical cure of hernia; viz., the possible excitation of a dangerous amount of peritonitis; and the want of adhesion between the lower part of the scrotal plug and the corresponding side of the inguinal canal and ring, and consequent failure in the complete occlusion of the canal and in the radical cure.

So far as the first objection is concerned, I believe that very little weight can be attached to it. I have very often performed this operation, and have never seen the slightest evidence of a disposition to peritoneal inflammation or other local mischief, except abrasion of the skin in one or two cases. With respect to the second objection, there can be no doubt that failures are not unfrequent; but on the other hand successes are not rare, and I have now under observation several cases in which a complete cure has resulted, although several years, from two to nine, have elapsed since the operation.

**Wood's Operation.**—In order to secure the more complete obliteration of the canal, and especially the cohesion of the inner and posterior walls, John Wood has brought forward another operation, for the following description of which I am indebted to him. The principle of this method consists in the approximation of the tendinous structures forming the boundary of the hernial canal, by the application of a subcutaneous wire suture through a puncture in the skin. In applying this principle to inguinal hernia, in order to promote the adhesion of the tendinous surfaces, and to protect the sac and cord from injurious violence, the highly vascular, elastic, and tough fascia of the scrotum is detached subcutaneously from the skin, transplanted by invagination into the canal and held there by the ligatures till adhesion ensues to the walls of the canal and to the spermatic cord. The wire is so applied as to obtain a fair hold in two places upon the structures forming the posterior wall, viz., the conjoined tendon and the triangular aponeurosis; and again upon Poupart's ligament and the lower portion of the external oblique aponeurosis forming the anterior wall of the canal. The effect of the suture is to close also the external abdominal ring, the pillars of which are included in its grasp. By the close adhesion which is thus produced between the posterior and anterior walls of the canal, the former is made to act like the limb of a valve in preventing the descent of a hernia into the canal. Thus a permanent resistance to the reproduction of the rupture is provided, which remains even after the temporarily effused lymph has been re-absorbed. The impulsive force of the abdominal contents tending to protrude at the internal ring, is resisted by the valve-like action of the posterior wall, and is not enabled to exert itself upon the recently formed adhesions. The use of the truss, except as a temporary adjunct in the cure, is rendered unnecessary by this operation.

*Operation.*—The patient being laid on his back, with the shoulders well raised, and the pubes and scrotum shaved, the hernia must be reduced and held up by an assistant pressing upon the internal opening. The operator, standing at that side of the patient which is about to be operated on, makes, with a small tenotomy-knife, an incision about three-fourths of an inch long through the skin of the scrotum over the lower part of the tumour ; or, if this be large, about two and a half inches below the pubic spine. Then the knife, being inserted flatwise between the skin and the fascia, is made to separate them around the incision over an area of about a two-inch circle ; a proceeding which the loose attachment of the skin easily allows. The knees of the patient should next be drawn up towards the abdomen, and held together so as to relax the structures connected with Poupart's ligament. The forefinger is next passed through the opening in the skin, and made to invaginate the detached fascia through the external ring into the canal, which is best done by using the right hand for the right side, and *vice versâ*, keeping the palm directed forwards. The invagination of the fascia should be commenced from as low a point as the cutaneous incision will permit, so as to push the invaginated finger as much as possible between the sac of the hernia and the spermatic cord. When the finger is in the canal, its point should reach the internal opening of the hernia, and the cord should be distinctly perceptible to it and protected by it. The point of the finger will then be placed behind the lower border of the internal oblique, and must render this point prominent at the surface by being hooked forward. The Surgeon will then be sensible of the edge of the conjoined tendon, raised in relief to the inner side of the invaginating finger, and in contact with its radial border. Next, the needle, stout, blunt-pointed, and curved, mounted on a strong handle, is to be passed along the radial border of the finger as far as just beyond the extreme joint, at which point it is made to pass through the conjoined tendon and the external oblique aponeurosis, till it is seen to raise the skin. The latter is then to be drawn upwards and inwards as far as possible before the needle is pushed through it. Then a stout copper wire, silvered, about two feet long, and bent into a convenient hook at each end, is hooked on to the eye of the needle ; and the latter is withdrawn and unhooked, leaving the lower end of the wire in the scrotal incision, and the upper end in the groin-puncture. The invaginating finger is then placed on the outer side of the cord, behind Poupart's ligament, as far from the border of the external ring as possible, raising the ligament on its point.

The needle is then passed along the ulnar border of the finger, and pushed through the external pillar close to Poupart's ligament opposite to the internal ring, the skin being drawn outwards till the point of the needle appears at the former puncture, through which it is then pushed. The upper hook of the wire is then hooked on and drawn down with the needle into and through the scrotal incision. Next, the spermatic cord opposite to the scrotal incision is to be carefully separated from the sac of the hernia by the finger and thumb, placed upon the skin in the same manner as in the operation for ligaturing varicocele. The needle, detached again from the wire, is then passed into the lower angle of the scrotal incision, and made to traverse the tissues between the cord and the hernial sac, and to emerge at the upper angle of the incision. The inner end of the wire is then hooked on to the needle and drawn with it across between the cord and sac. A little care must here be taken to avoid any kink in the wire, which must be drawn down until the part which remains in the wound is quite straight. The ends of the wire are then twisted to the extent of three turns, which it will be found useful, when removing the wire, always to make in the same direction. Traction is then made upon the wire loop which remains in the groin-puncture. This will be found to invaginate the sac and scrotal fascia, and to close up the pillars of the external abdominal ring. The loop must then be twisted by three firm turns well drawn into the groin-puncture. Then the long ends of the wire, being cut off to a suitable length, are to be passed together through the loop bent down to meet them and hooked on to it. Under the arch thus formed a stout pad of lint is placed, and the whole is held firmly by a spica bandage.

The patient, after the operation, should be placed in bed with the shoulders well raised and the knees bent over a bolster. Any discharge which forms has a free escape downwards, and may be received upon a sponge steeped in some antiseptic fluid. The scrotum should be either suspended in a turn of the bandage, or kept up by a small cushion or strap of plaster.

The wires should be kept in from fourteen to twenty-one days, according to the amount of solid effusion which subsequently occurs. Any pain in the abdomen should be allayed by opiates and fomentations, and by slackening or removing the bandage after forty-eight hours. Pain sometimes results from including the ilio-inguinal nerve, which must not be mistaken for the pain of peritonitis.

Wood had up to 1872 operated in nearly 200 instances, and estimated his successful results in cases of all degrees of severity at about sixty-five per cent. In young persons the results have been still more favourable, and he now confines the operation to patients below the age of thirty, unless in special circumstances. Three deaths have resulted from pyæmia and peritonitis.

## IRREDUCIBLE HERNIA.

**Irreducible Herniæ** are usually of old date, and of large size. They generally contain a considerable quantity of thickened omentum, as well as intestine and mesentery. In many instances, a rupture of this kind is partly reducible, the greater portion remaining unreduced. It is usually the gut which slips up, and the omentum that cannot be returned.

CAUSES OF IRREDUCIBILITY.—The irreducibility of a rupture may be dependent on either its *shape*, on the existence of *adhesions*, or on its very *nature*. If the sac become the seat of an hour-glass contraction, or its neck become elongated and narrowed, the hernial contents may continue permanently protruding. So also, the expanded condition of the lower part of the omentum, and the narrowing of its neck, may prevent a return of the rupture. The existence of adhesions, either between the sac and its contents, or between protruded intestine and omentum, will commonly render a hernia irreducible; and most frequently these are associated with changes in the shape of the sac or of the omentum. Herniæ of the cæcum and bladder can never be returned, on account of the anatomical conditions, to which reference has already been made.

SYMPTOMS.—An irreducible hernia is usually a source of great inconvenience; it has a tendency to increase if left to itself, until at last it may contain, as in some extreme cases it has been found to do, the greater portion of the abdominal viscera, forming an enormous tumour, inconvenient by its size and weight, in which the penis and scrotum are buried. Even when the irreducible hernia is of small size, it gives rise to a sensation of weakness in the part, with dragging pains, and is very frequently accompanied by colicky sensations and dyspeptic derangements. The patient also, in these circumstances, is in a state of considerable danger lest the rupture become strangulated by violent efforts, or injured and inflamed by blows.

TREATMENT.—For the above reasons it is necessary not only to protect a rupture of this kind from external violence, but to endeavour to prevent its increase in size. This may best be done by letting the patient wear a truss with a large concave pad, which supports and protects it; provided the rupture be not of too great a size for the application of such an instrument. If its magnitude be very considerable, it must be supported by means of a suspensory bandage. Bransby Cooper has recommended that an attempt should be made to convert the irreducible into a reducible hernia, by keeping the patient in bed for several weeks, on low diet, with the continued application of ice to the tumour; and, if it contain much omentum, giving small doses of blue pill and tartar emetic, so as to promote the absorption of the fat. For these remedies I have advantageously instituted the iodide of potassium. This plan, which appears to have answered well in some cases, certainly deserves a further trial.

**Inflamed Irreducible Hernia.**—The occurrence of inflammation in an irreducible hernia is a serious complication, and one that simulates strangulation very closely. When this complication occurs, the part becomes swollen, hot, tender, and painful; there is not much tension in the tumour, which is seldom increased beyond its usual magnitude; there is a good deal of pyrexia, and symptoms of peritonitis spreading from the vicinity of the inflamed rupture set in. In some cases there is vomiting; but it is not constant, and never feculent, occurring generally early in the disease, and consisting principally of the contents of the stomach; being apparently an effort of nature to get rid of an indigestible meal. If there be constipation, as usually happens in all cases of peritonitis, it is not complete, flatus occasionally passing *per anum*, together with a small quantity of fluid fæces. It is of importance in these cases to observe that the inflammation commences in the body of the sac, and extends into those parts of the abdomen that are contiguous to its neck; the stomachal and intestinal derangements being secondary to this consideration.

The *Treatment* of an inflamed irreducible hernia must be directed to the peritonitis which attends it. The application of leeches over the sac and its neck, the free administration of calomel and opium, and the employment of enemata, with strict antiphlogistic regimen and rest, will usually speedily subdue all inflammatory action.

**Incarcerated Hernia.**—An irreducible hernia occasionally becomes obstructed, then constituting the condition termed *incarcerated hernia.* This condition principally occurs in old people, from the accumulation of flatus, or of undigested matters, such as cherry-stones or mustard-seeds, in an angle of the gut. In these cases there is constipation, with eructation, and perhaps occasional vomiting. There may be some degree of pain, weight, or uneasiness about the tumour; but there is no tension in it or in its neck, and the symptoms altogether are of a chronic and subacute character.

The *Treatment* of such a case as this should consist in the administration of a good purgative injection; the compound colocynth enema is the best, thrown up as high as possible by means of a long tube. Ice may then be applied to the tumour for about half an hour; and the taxis, as will afterwards be described, may be used under chloroform. The ice may be omitted in those cases in which, on handling the tumour, gurgling can readily be felt; but the taxis should always be used, as by it the incarcerated gut may be partially emptied of its contents; or if any additional protrusion should have slipped down, this may be returned. After these means have been employed, an active purgative, either of calomel or of croton-oil and colocynth, should be administered; and, if any inflammation ensue, this must be treated as already described.

## STRANGULATED HERNIA.

A hernia is said to be **Strangulated** when a portion of gut or omentum that is protruded is so tightly constricted that it cannot be returned into the abdomen; having its functions arrested, and, if not relieved speedily, running into gangrene. This condition may occur at all periods of life, being met with in infants a few days old, and in centenarians. It commonly arises from a sudden violent effort, by which a fresh portion of intestine is forcibly protruded into a previously existing hernia, which it distends to such a degree as to produce strangulation. But, though old herniæ are more subject to this condition than recent ones, it may occur at the very first formation of a hernial swelling, the gut becoming strangled as it is protruded. There are therefore two distinct kinds of strangulation. One may be said to be of a passive kind, chiefly occurring in elderly people, the subjects of old and perhaps irreducible hernia; which, in consequence of some accidental circumstance, becomes distended by the descent of a larger portion of intestine than usual, and this, undergoing constriction and compression at the neck of the sac, gradually becomes strangulated. The other kind of strangulation is most frequent in younger individuals; in it the symptoms are more active, the bowel becoming protruded in consequence of violent exertion, and undergoing rapid strangulation, the tension of the parts not having been lessened by the previous long existence of an irreducible hernia.

Mechanism of Strangulation.—Strangulation has been attributed either to a spasmodic action of the walls of the aperture through which the hernia protrudes, or to changes taking place in the protruded parts, subsequent to and occasioned by their constriction by the tissues external to them. The strangulation cannot, I think, ever be regarded with justice as of spasmodic character; the aperture in the abdominal wall, through which the hernia escapes, being tendinous or fibrous, and certainly not in any way contractile, though the action of the abdominal muscles may undoubtedly increase the tension of its sides. The continued and permanent character of the strangulation, when once it has taken place, would also discountenance this opinion; those forms of hernia, indeed, as the ventral, which occur in purely muscular structures, are very rarely strangulated, and, when they are so, the constriction is generally occasioned by the formation of dense adventitious bands upon or within the sac, and not by any muscular agency.

Strangulation is characterised by congestion of the protruded parts, induced by the constriction to which they are subjected; the mechanism being as follows. A knuckle of intestine, or piece of omentum, is suddenly protruded during an effort of some kind. This immediately becomes compressed by the sides of the narrow aperture through which it has escaped; the return of its venous blood is consequently interfered with, and swelling and œdema rapidly ensue, together with stagnation of the blood in it. If the constriction be excessively tight, the walls of the ring being very hard and sharp, the part that is so strangulated may be deprived of its vitality in the course of a few hours. If the strangulation be less severe, the congestion will run into inflammation, the changes characteristic of this condition speedily supervening. In proportion as the congestion augments, and the inflammation comes on, the return of the protruded parts is necessarily rendered more difficult by the increase of their swelling.

Seat of Stricture.—The stricture is most commonly situated outside the neck of the sac, in the tendinous or ligamentous structures surrounding it; not unfrequently in the altered and thickened subserous areolar tissue. In other cases, and indeed with great frequency, it is met with in the neck of the sac itself (Fig. 673), which is narrowed, elongated, and tubular; or constricted by bands that are incorporated with it. More rarely it exists in the body of the sac, which may have assumed an hour-glass shape. In some cases, it would appear as if this particular shape were owing to an old hernia having been pushed down by a recent one above it. The stricture is sometimes, though by no means frequently, met with inside the sac, consisting of bands

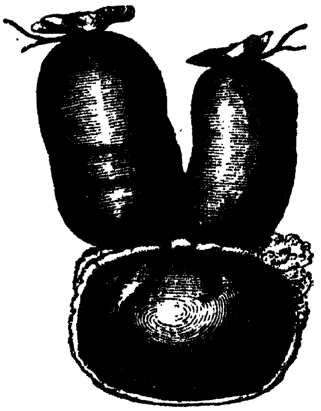


Fig. 673.—Stricture in the Neck of the Sac, laid open.

of adhesions stretching across this, or of the indurated edge of an aperture of the omentum through which a portion of the gut has slipped.

LOCAL EFFECTS OF STRANGULATION.—The changes induced in the strangulated parts result from the pressure of the stricture, and the consequent interference with the circulation through them. If the strangulation be acute, that portion of intestine which lies immediately under the stricture will be seen to be nipped or marked by a deep sulcus, occasioned partly by the pressure to which it has been subjected, and partly by the swelling of the congested tissues beyond it. The changes that take place in the protruded intestine rapidly increase in proportion to the duration of the strangulation. The tightness of the stricture and the acuteness of the strangulation have, however, even more to do with these changes than its duration. I have seen the bowel so tightly nipped that, though the strangulation had only existed eight hours when the operation was performed, the vitality was lost in the part constricted (Fig. 679); and in other cases I have known the part to recover itself, although strangulation had lasted for five or six days before the operation was performed.

The first change that takes place in the protruded parts in the case of strangulated hernia is their *congestion;* this rapidly runs on to inflammation, and speedily terminates in gangrene. The protruded bowel becomes, at first, of a claret, morone, or purplish-brown colour, sometimes ecchymosed on the surface, with thickening and stiffening of its coats, owing to effusion into their substance; some liquid is also usually poured out into its interior. In this stage, that of congestion, the omentum will also be found with its veins a good deal congested. When *inflammation* has set in, the bowel preserves the same colour as in the congested condition, but usually becomes coated here and there with flakes of lymph, which gives it a rough and villous look; the omentum has a somewhat rosy tinge, and there is usually a good deal of reddish fluid poured out into the sac. When *gangrene* occurs, the bowel loses its lustre and polish, becoming of an ashy grey, or dull black colour, soft and somewhat lacerable, so that its coats readily separate from one another; the serous membrane especially peeling off. The omentum is dark purplish, or of a kind of dull yellowish-grey; and there is usually a considerable quantity of dark turbid serum in the sac, the whole contents of which are extremely offensive. Most usually, when gangrene occurs in a strangulated rupture, inflammation of the sac and its coverings takes place, accompanied, after a time, by a reddish-blue or congested appearance and some tenderness on pressure; and, if the part be left unreduced, eventually by emphysematous crackling. If the case be left without being relieved, gangrene of the skin will at last take place; the sac giving way, and the fæcal matters being discharged through the softened and disintegrated tissues. In such circumstances as these—which, however, are very rarely met with at the present day—the patient usually eventually dies of low peritonitis, from extension of the inflammation to the serous membrane. No effusion, however, of feculent matter will take place into the peritoneal cavity, even under such favourable conditions; the portion of bowel immediately within the stricture becomes adherent by plastic matter to the peritoneum on its internal surface, and thus the escape of any extravasation into the cavity of the abdomen is prevented. It does not always follow that there is any external evidence of the occurrence of gangrene within the sac; and the bowel is frequently nipped to such an extent as to prevent its regaining its vitality, without any unusual condition being presented until the sac is actually laid open and the intestine examined.

The *fluid* contained in the hernial sac undergoes changes in appearance and character, corresponding to those which take place in the strangled gut. In earlier and slighter cases it continues clear and but moderately abundant. Sometimes the quantity increases greatly and rapidly, but more commonly the chief alteration that takes place is in its *character*. It becomes reddish or brown in colour from transuded blood. Sometimes even pure blood is found in the sac, and I have seen the protruded intestine invested with a layer of coagulum. If gangrene of the gut take place, the fluid becomes turbid, dark, and offensive. Suppuration in the sac is very rare. I have only once met with it in a woman, 32 years of age, three months pregnant, who was suffering from an acutely strangulated femoral hernia of sixty hours' duration. In that case, the taxis had been freely used. Fluctuation could be felt deeply, there was diffused doughy infiltration of the groin, and on opening the sac it was found filled with dark thick pus—about half an ounce; at the bottom of which lay a small deeply congested but not gangrenous knuckle of intestine, which was replaced after the division of a very slight stricture. The patient recovered.

In the more advanced cases of strangulated hernia, the peritoneum always becomes inflamed, usually to a considerable extent; the disease affects a diffuse form, and is accompanied by the effusion of turbid serum, often of a very acrid and irritating character, and mixed with flakes of lymph, sometimes to such an extent as to give it a truly puriform appearance. This glutinous lymph mats together contiguous coils of intestine, often appearing to be smeared over them like so much melted butter.

SYMPTOMS.—The signs and symptoms of strangulation are of two kinds: 1. The local ones, affecting the Tumour; and 2. The general ones, influencing the Constitution.

1. **Local Signs.**—The tumour, if the hernia be an old one, will be found to be increased in size; or it may have appeared for the first time. At the moment of strangulation it will generally be found to be hard, tense, and rounded, more particularly if it be an enterocele. When, however, the hernia is in a great measure omental, it is not unfrequently soft and doughy, though strangulated. It seldom increases in size after strangulation has occurred, as no fresh protrusion can take place below the stricture; but I have known it to be greatly augmented in bulk after the strangulation had existed for some hours, by the effusion of serum into the sac. If the hernia have previously been reducible, it can no longer be put back; and there is no impulse in it nor increase in its size on coughing, the stricture preventing the transmission of the shock to the contents of the tumour; and in this way, as pointed out by Luke, the situation of the constriction may sometimes be ascertained by observing at what point the impulse ceases.

2. **Constitutional Symptoms.**—So soon as the strangulation has occurred, intestinal obstruction takes place, and the patient becomes uneasy and restless. If the constriction be of an active character, he will be seized with acute pain

in the part, which speedily extends to the contiguous portion of the abdomen, assuming the characters of peritoneal inflammation. The first thing that happens when intestine is strangulated, whether a large coil be constricted, or a small portion only of the diameter of the gut be nipped, is an arrest of the peristaltic movement of the part implicated; and the occurrence of obstruction to the onward course of the intestinal contents is followed by constipation, vomiting, and colicky pains. The constipation is always complete, neither fæces nor flatus passing through; the bowels may sometimes act once after the strangulation has occurred from that portion which lies below the seat of constriction, but they cannot, of course, empty themselves thoroughly, nor from above the strangled part.

Vomiting usually sets in early, and is often very severe and continuous, with much retching and straining; at first the contents of the stomach are ejected, with some bilious matters, but afterwards the vomiting becomes feculent, or stercoraceous. The cause of feculent vomiting has usually been supposed to be an inverted peristaltic action of the intestines. But the observations of Dr. Brinton seem to throw much doubt on the correctness of this time-honoured view. Dr. Brinton maintains that in vomiting, the result of obstructed or strangulated intestine, the peristaltic action is not inverted—that it continues to be direct—but that when the intestinal contents meet with the obstruction, they undergo a kind of churning, and that a central upward current takes place; the contents of the bowel being forced upwards by the pressure of the accumulated substances at the seat of obstruction, and consequently behind them. The vomiting is attended by colicky and dragging pains about the navel. These symptoms are more severe in their character when the strangulation is acute and the hernia is intestinal, than when it is passive, and the rupture omental. They occur equally in the incomplete and the complete forms of the disease; indeed, it not unfrequently happens that the hernial tumour may be so small as to have escaped observation; the occurrence of the above-mentioned symptoms being the first indication of the probable nature of the mischief. Hence, it is well always to examine for hernia when called to a patient suddenly seized with constipation, vomiting, and colicky pains, even if told that no tumour exists.

After the strangulation has existed for some time, the inflammation that occurs in the sac extends to the contiguous peritoneum, accompanied by the ordinary signs of peritonitis, such as tension of the abdominal muscles, tenderness, with lancinating pains about the abdomen, and tympanitis. The patient lies on his back with the knees drawn up, has a small, hard, quick, and perhaps intermittent pulse, a dry tongue which speedily becomes brown, and a pale, anxious, and dragged countenance, with a good deal of heat of the skin, and inflammatory fever. In some cases, this is of a sthenic type; but, in the majority of instances, especially in feeble subjects, it assumes the irritative form. When gangrene of the rupture takes place, hiccup usually comes on, with sudden cessation of pain in the tumour, and intermittent pulse, cold sweats, pallor, anxiety, rapid sinking of the vital powers, usually with slight delirium; and death speedily occurs.

**Modifications of Symptoms.**—The symptoms just described are those which are usually met with in strangulated hernia. They may, however, be modified in some important respects.

1. There may be little or no tension in a strangulated hernia, the tumour continuing soft and lax; this is especially the case when the hernia contains omentum, and in congenital herniæ when strangulated. It may also occur in the case of double herniæ on the same side, in consequence of the outer sac being empty, or merely filled with serum, and the posterior one being protruded against this and strangulated, but its tension being masked by the lax state of the outer one.

2. Vomiting sometimes does not take place from first to last, there being at most a little retching; at other times the patient vomits once or twice, and then there is no recurrence of this symptom so long as he remains quiet, and keeps the stomach empty; but, on moving or taking nourishment of any kind, even fluids, it comes on again, and thus the Surgeon may *elicit* this symptom, should it be necessary in a diagnostic point of view.

3. Extensive peritonitis, with copious effusion of a puriform liquid, may occur without any pain, and with but little tenderness and no elevation of temperature; the anxiety of countenance and sharpness of pulse being the only symptoms that lead to a suspicion of its existence.

4. Death may result from exhaustion consequent on vomiting and peritonitis, without any sign of gangrene in the constricted portion of intestine.

DIAGNOSIS.—The diagnosis of strangulated hernia requires to be made from the following conditions.

1. **Obstructed Irreducible Hernia.**—In this there are no acute symptoms, and the rupture will generally be found to be a large one of old standing. It may become somewhat tense and swollen, but is not tender to the touch, and always presents a certain degree of impulse on coughing. There is no sign of peritonitis. There may be constipation; but there is no vomiting, or, if there be any, it is simply mucous and bilious, consisting of the contents of the stomach. The speedy restoration of the intestinal action, by the treatment already indicated as proper in these cases, will remove any doubt as to the nature of the affection.

2. **Inflamed Irreducible Hernia.**—Here there are great tenderness and pain in the tumour, with pyrexia, and some general peritonitis, but there is no vomiting; or, if the patient have vomited once or twice, he does not continue to do so with the same degree of violence, or in the same quantity, as he would if the peritonitis were the result of strangulation. Again, the constipation is not absolute and entire, but flatus and liquid fæces will usually pass.

3. **General Peritonitis conjoined with Hernia.**—Here the diagnosis is often extremely difficult, especially if the hernia be an irreducible one. In these cases, however, it will be observed that the peritonitis may be most intense at a distance from the sac; that there will be little or no vomiting, or, if there be, that it is simply of mucus and the contents of the stomach; and that the constipation is by no means obstinate or insurmountable by ordinary means.

4. In **Double Hernia**, one tumour may be strangulated and the other not, though irreducible. In these circumstances, it may at first be a little difficult

to determine which one is the seat of constriction. This, however, may be ascertained by observing greater tension and tenderness about the neck of the strangulated than of the unconstricted hernia.

5. The co-existence of **Early Pregnancy**, or a **threatened Miscarriage**, may obscure the diagnosis, the Surgeon possibly being in doubt whether the vomiting is dependent on the state of the uterus or on the strangulation of the hernia. Here it may be stated generally that the vomiting of pregnancy never becomes stercoraceous ; that constipation, if it exist, does not resist the action of aperients or enemata ; and that the local signs of strangulation are usually well marked.

Besides these various conditions of hernia, which may be confounded with strangulation, there are other tumours which may be mistaken for this disease ; but these we shall have to consider when speaking of the special forms of hernia.

TREATMENT.—The treatment of strangulated hernia is one of the most important subjects in surgery. The object sought to be accomplished is the removal of the constriction from the strangled hernial tumour. This is effected either by the Reduction of its Contents by Taxis ; or by the Division of the Stricture.

**Taxis.**—The reduction of the hernia is effected by the employment of the taxis, by which is meant the various manual procedures employed in putting the rupture back. The taxis, when properly performed, is seldom attended by any serious consequences to the patient. I have never known it followed by death ; and, out of 293 cases of hernia reported by Luke, as having been reduced by the taxis in the London Hospital, none died. It is not unfrequently followed, however, by rather a sharp attack of peritonitis, which might probably, in some instances, prove fatal ; in one instance, I have seen it followed by very abundant hæmorrhage from the bowel, probably owing to the rupture of some of the congested vessels of the strangled portion of the gut. In using the taxis, great care should in all cases be employed, and no undue force should ever be had recourse to. No good can ever be effected by violence : the resistance of the ring cannot be overcome by forcible pressure ; and a vast deal of harm may be done by squeezing against it the tender and inflamed gut, causing this to overlap, and thus to be bruised, or even perhaps torn. The taxis should not be prolonged beyond half an hour ; if it be properly employed for this time, the hernia, if reducible, will probably go back. If it be applied, as it is often very improperly, for a lengthened period, and by several Surgeons in succession, the protruded part becomes ecchymosed, irritated, and disposed to inflammation ; and the chances of recovery after a subsequent operation are much lessened. When the parts are much inflamed, the taxis should be employed with great caution ; and, if it have been fairly and fully used by another Surgeon, it is better not to repeat it. When gangrene has occurred, the taxis should never be employed ; as the putting back of the mortified gut into the abdomen would be followed by extravasation of fæces and fatal peritonitis.

In using the taxis, it should be borne in mind that there are two obstacles to overcome ; the resistance of the parts around the ring, and the bulk of the tumour. The first may be somewhat lessened by relaxing the abdominal muscles, and consequently diminishing the tension exercised upon the tendinous apertures and fasciæ of the groin. In order to effect this, the patient should be placed in a proper position, the body being bent forwards, the thigh adducted, and semi-flexed upon the abdomen; the Surgeon may then, by employing steady pressure on the tumour, endeavour to squeeze out some of the flatus from the strangled portion of intestine, and thus to effect its reduction. In doing this, the neck of the sac should be steadied by the fingers of the left hand; whilst, with the right spread over the tumour, the Surgeon endeavours to push it backwards, using a kind of kneading motion, and sometimes in the first instance drawing it slightly downwards, so as to disentangle it from the neck of the sac. The direction of the pressure is important; it should always be in the line of the descent of the tumour. These means may be employed as soon as the patient is seen by the Surgeon, when, by steadily carrying on the taxis for a few minutes, he will perhaps hear and feel a gurgling in the tumour, which will be followed by its immediate reduction. If the patient be thin, and the outline of the aperture through which the hernia escapes tolerably defined, the protrusion may be reduced, after failure of the taxis in the ordinary way, by passing the tip of the finger or the nail under the edge of the ring, and pulling this firmly and forcibly on one side, so as to steady and at the same time dilate it, pressure being kept up on the tumour with the other hand. This manœuvre can be practised with more facility and success in femoral hernia, where the upper edge of the saphenous opening is sharply defined, but may also successfully be had recourse to in inguinal and umbilical protrusions. In some cases reduction appears to have been facilitated by placing the patient on his head and shoulders, and raising the body in the vertical position whilst the taxis was being employed. Should, however, reduction not ensue, it will be desirable to have recourse at once to further means, the object of which is, by relaxing the muscles and lessening the bulk of the tumour, to enable the hernia to be reduced.

**Auxiliary Measures.**—The means to be employed must be modified according to the condition of the strangulation, whether it be of the active or of the passive kind. If it be very acute, occurring in a young, robust, and otherwise healthy subject, the patient may have about twelve or sixteen ounces of blood taken away from the arm; he should then be put into a hot bath, where he may remain for twenty minutes or half an hour, or until he feels faint; and, whilst he is in the bath in this condition, the taxis should be employed. If it do not succeed, he should be taken out, wrapped up in blankets, and have chloroform administered. When he is fully under the influence of this agent, which is certainly the most efficient which we possess for relaxing muscular contraction, the taxis may be tried once again. Should it still fail, operation should be immediately proceeded with. No good can possibly come of delay in these cases, and repeated attempts at the taxis should be carefully avoided. If the hernia do not admit of reduction in the early stage of the strangulation, it will necessarily be much less likely to do so when the parts, squeezed and bruised much by manipulation, will have had their congestive condition greatly increased. The frequent employment of the operation without opening the sac, of late years, very properly renders Surgeons much less averse to early division of the stricture than was formerly the case.

When the strangulation is less acute, or occurs in a more aged or less robust subject, it is well to omit the bleeding, and to trust to the warm bath and chloroform.

When the strangulation is of a passive character, and occurs in feeble or elderly people, other measures may be adopted with the view of lessening the bulk of the tumour; which, rather than the tension of the parts, offers the chief obstacle to reduction in these cases. In such circumstances, especially when the tumour is large and not very tense, it is well to dispense with the hot-bath, which has sometimes a tendency to increase any congestion that may already exist in the hernia; I have in more than one case seen a strangulated rupture enlarge considerably after the employment of the bath. In such cases, more time may safely be spent in attempts at reduction than in very acutely strangulated herniæ. It is a useful practice to commence the treatment by the administration of a large enema; which, by emptying the lower bowel, will alter the relations of the abdominal contents, and may materially facilitate the reduction of the tumour. The best enema is one of gruel and castor-oil, with some spirits of turpentine added to it; it should be injected through a full-sized tube, passed high up into the gut, and with a moderate degree of force. In administering it, care must be taken that no injury be done to the bowel. It would scarcely be necessary to give such a caution as this, were it not that I was summoned, some years ago, by two very excellent practitioners, to see a woman with strangulated femoral hernia, to whom an enema of about two quarts of tepid water had been administered; and as this had not returned, and did not appear to have gone up the bowel, they suspected that it must have passed out of the rectum into the surrounding areolar tissue. As the patient, however, did not seem to be suffering from this cause, and as the symptoms of strangulation were urgent, I operated on the hernia. Death suddenly occurred, apparently from exhaustion, in about eight hours; and, on examining the body, it was found that the rectum had been perforated, and the fluid injected into the meso-rectum, separating the gut from the sacrum, whence it had extended into the general subperitoneal areolar tissue, which contained a quantity of the liquid; some of the water also appeared to have entered the peritoneal cavity.

In the large herniæ of old people, more particularly the umbilical, in which there is a good deal of flatus, after the enema has been administered, a bladder of ice may be applied for three or four hours with excellent effect. Chloroform may then be given, and the taxis employed under its influence. Of late years, indeed, I have been in most cases in the habit of trusting almost solely to chloroform as a relaxing agent, and have often even dispensed with the use of the warm bath. If however, this can be conveniently used without too much delay, it should be employed. After this, I put the patient at once under chloroform, and then try the taxis for a period not exceeding half an hour: if this fail, the operation should be done without making any further attempts at reduction, which are not only useless, but injurious by bruising the protruded parts.

**Persistence of Symptoms after Reduction.**—After the reduction of the hernia, the symptoms of strangulation may continue unabated. This untoward occurrence may arise from four distinct conditions: 1. The hernia may have been reduced in mass (*vide* p. 652, Vol. II.) ; 2. An internal strangulation has existed within the sac—the taxis having overcome the external stricture, but failing to influence that within the sac ; 3. The gut may have been so severely nipped that, although all constriction has been removed, the peristaltic action is not restored, the constricted portion of bowel falling into a state of gangrene ; 4. A second hernia may exist in a state of strangulation, which has escaped detection.

The diagnosis of these several conditions may possibly be made by attention to the following circumstances. In the *reduction in mass* the tumour has slipped up without any gurgle ; the canal is very open, and no trace of sac can be felt in it, but a rounded tumour, possibly at the upper part, on coughing. In the case of *internal adhesions* there will have been no gurgling, but the canal is still filled by the sac ; the abdominal apertures are not preternaturally patent and distinct. In the case of *extreme nipping* and consequent paralysis of a portion of the gut, gurgling will have been felt and heard in effecting the taxis, which does not happen in either of the other conditions, and the symptoms of intestinal obstruction will not be quite complete. The vomiting will lose its stercoraceous character, and probably some flatus will pass. In the case of the *co-existence of a second hernia* in a state of strangulation, the cause of the continuance of the symptoms may be ascertained by careful examination of the abdominal walls. It is especially the co-existence of a small femoral with a large umbilical or inguinal hernia that is apt to be overlooked. This I have seen happen in a very fat person. A man was admitted into University College Hospital with strangulated inguinal hernia. It was reduced by the house-surgeon, but the symptoms persisted, and the patient died unrelieved, there being no indication for operation. After death a very small piece, half a knuckle, of intestine was found strangulated in the crural canal of the same side. The patient being extremely fat, this strangulation was not detected, and could not be recognised during life. The folds of the groin should be very carefully examined in all these cases.

The **Treatment** of these different conditions is full of difficulty and of anxiety to the Surgeon. As a general rule, I think that the proper practice in all cases when the symptoms of strangulation, especially stercoraceous vomiting, continue *unrelieved and undiminished in severity* for some hours after the apparent reduction of the hernia, is to cut down upon the canal, expose the sac, and, if that be found still strictured, as will be explained at p. 637, Vol. II., divide the constriction. Should the hernia not have been reduced "in mass," it might possibly be found that a small knuckle of intestine is still gripped at the inner and deeper ring ; but should that not be the case, it will, I think, be safer not to push any exploration into the abdominal cavity with the view of discovering the possible existence of unrelieved internal strangulation, the presence of which would be highly problematical, and, if existing, could scarcely admit of discovery. The safer and wiser plan under such circumstances appears to be, to leave the wound open, with a poultice and a light compress over it, and to give the patient the chance of the formation of an artificial anus on the sloughing of the strangulated or badly nipped knuckle of intestine ; a result that I have more than once witnessed about the fourth or fifth day, the patient ultimately recovering.

In some cases, where the nipping of the strangulated intestine has been severe, yet not sufficient to arrest permanently the peristaltic action or to destroy its vitality, constipation and retching, with nausea, may continue; and the tumour, if the hernia have been small and deeply seated (more particularly if femoral), may continue to be felt, though less tense than before; consisting simply of the thickened and inflamed sac, with serous fluid in it. In these circumstances, we must be careful not to operate. I have, on two or three occasions, seen an empty sac operated on to the annoyance of the Surgeon and danger of the patient. The mistake may be avoided by observing that the symptoms gradually lessen in severity by waiting, and that the tympanitis subsides, the abdomen becoming flat and supple.

The length of time during which the congestive condition of the bowel will continue after a strangulated portion of intestine has been reduced, is very considerable. In a case of strangulated femoral hernia which was some time ago under my care, reduction was effected, but, strangulation recurring at the end of twelve days, an operation became necessary; this was performed, and the patient died on the eighth day after it, or the twenty-first from the first strangulation. On examination, the small intestine was found congested in two distinct portions, each of which was about eight inches in length; several feet of healthy gut intervening between them. One of these congested portions lay opposite the wound, and was evidently the intestine that was last strangulated. The other was altogether away from the seat of operation, but was equally darkly congested, being almost of a black colour, and was clearly that portion which had been constricted some time previously; and which, although twenty days had elapsed, had not as yet recovered itself. When a second strangulated hernia exists it, of course, must either be reduced by the taxis, or the operation practised on it.

After the taxis has been fairly employed for a sufficient time, and has not succeeded in reducing the hernia, the operation must be proceeded with. It is impossible to lay down any definite rule as to the time that it is prudent to continue efforts at reduction; but it may be stated generally that, after the different adjuvents of the taxis which the Surgeon may think it desirable to apply have been fairly tried and have failed, the operation should be undertaken without further delay. There are few Surgeons who will not at once acknowledge the truth of the remark of the late Hey of Leeds—that he had often regretted performing this operation too late, but never having done it too early. It is true that cases are occasionally recorded, in which after four or five days of treatment the hernia has gone up; but it is very rare to meet with such cases in practice; and, in all probability, in delaying the operation in the hope of finding one such case, the lives of dozens of patients would be sacrificed. Luke has shown, as the result of the experience at the London Hospital, that the ratio of mortality increases greatly in proportion to the length of time during which the strangulation is allowed to continue. Of 69 cases of strangulated hernia operated upon within the first 48 hours of strangulation, 12 died, or 1 in 5·7; whilst of 38 cases operated on after more than 48 hours had elapsed, 15 died, or 1 in 2·5. Indeed, one chief reason of the greater mortality from operations for hernia in hospital than in private practice, probably arises from the fact that much valuable time is frequently consumed before assistance is sought, or in fruitless efforts to reduce the swelling before the patient's admission. Not only is time lost in this way, but the bowel is often bruised and injuriously squeezed, so that the inflammation already existing in it is considerably increased.

### OPERATION FOR STRANGULATED HERNIA

The operation for strangulated hernia may be performed in two ways; either by opening the sac, exposing its contents, and dividing the stricture, wherever it is situated, *from within*; or it may be done by dividing the stricture *outside*, without opening the sac. In either case the great object of the operation, the division of the stricture by the knife, is the same; but the mode in which it is effected is different. We shall first describe the operation in which the sac is opened; afterwards that in which it is not; and then briefly compare the two procedures.

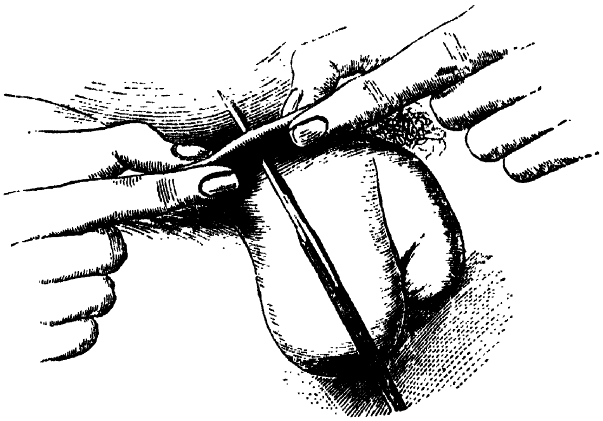


Fig. 674.—Operation for Hernia: Division of the Skin.

Operation in which the Sac is opened.—**Exposure of the Sac.**—The patient having been brought to the edge of the bed, or placed on a table of convenient height, the bladder is emptied, and the parts that are the seat of operation are shaved. The dissection of the hernial coverings in layers anatomically arranged, is never done at an operation. The Surgeon dissects, or rather cuts, down to the sac, then turns aside the coverings as a whole, and divides the stricture. He proceeds as follows: An incision of sufficient length is made over the neck of the sac; this may be best done by pinching up a fold of skin, pushing the scalpel through its base with the back of the instrument turned towards the hernia, and then cutting upwards (Fig. 674). A linear incision is thus made, which may be extended at either end if necessary; the dissection is then carried through the superficial fascia and fat with the scalpel and forceps. If any small artery spout freely, it had better be tied at once, lest the bleeding obstruct the view of the part in the subsequent steps of the operation. As the Surgeon approaches the sac, more caution is required, particularly if the subserous areolar tissue be dense, opaque, and laminated. The Surgeon must pinch this up with the forceps, make a small incision into it, introduce a director, and lay it open upon this, or on the finger (Fig. 675).

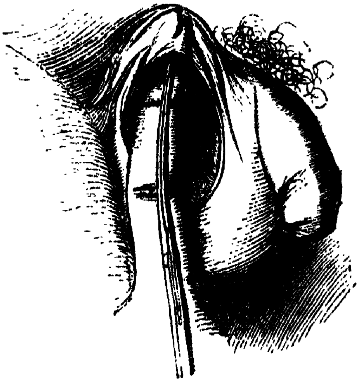


Fig. 675.—Operation for Hernia: Incision of Subserous Areolar Tissue.

If it be thin and not opaque, so as to admit a view of the subjacent parts, he may dissect it through with the unsupported hand. In this way he proceeds until the sac is reached, which is usually known by its rounded and tense appearance, its filamentous character, and by the arborescent arrangement of vessels upon its surface. In some cases the Surgeon thinks that he has reached the sac, when in reality he has only come upon a deep layer of condensed areolar tissue in close contact with it ; here the absence of all appearance of vessels, the dull and opaque character of the tissue and its more solid feel, together with the absence of the peculiar tension that is characteristic of the sac, will enable him to recognise the real state of things. In other cases, it may happen that the sac is so thin, and the superficial structures are so little condensed, that the Surgeon lays it open in the earlier incisions before he thinks he has reached it. In these circumstances a portion of the intestine protruding might be mistaken for the sac. This dangerous error may be avoided by observing the peculiarly smooth and highly polished appearance presented by the dark and congested gut, the absence of arborescent vessels, and the non-existence of any adhesions between its deeper portions and the tissues upon which it lies. If the sac be prematurely opened, the escape of fluid will indicate this ; and if omentum protrude, the granular appearance and peculiar feel of this tissue will at once cause its recognition.

**Opening the Sac.**—The sac, having been exposed, must be carefully opened ; this should be done towards its anterior aspect ; and, if it be a small one, at its lower part. It may best be done, if the sac be not very tense, by seizing a portion of it between the finger and thumb, and thus feeling that no intestine is included ; a small portion of it is then pinched up by the forceps, and an opening is made into it by cutting upon their points with the edge of the scalpel laid horizontally. If the sac be very tense, it cannot be pinched up in this way, and then it may best be opened by introducing the point of a fine hook very cautiously into its substance, raising up a portion of it in this way, and then making an aperture into it. There is little risk of wounding the gut in doing this ; for, as the tension of the sac arises from the effusion of fluid into it, a layer of this will be interposed between it and the gut. In these cases, the fluid sometimes squirts out in a full jet, and occasionally exists in a very considerable quantity. I have seen at least a pint of slightly bloody serum escape on opening the sac of an old strangulated inguinal hernia. Most frequently, however, there is not more than from half an ounce to an ounce ; and sometimes the quantity is considerably less than this. Sir James Paget very wisely attaches great importance to the character and appearance of the fluid in a hernial sac ; if this fluid be clear and transparent, of a yellow tint like serum, it is a good sign, as probably no great amount of congestion has taken place. If reddened by extravasation of blood, it is an evidence of increased congestion ; and the deeper the discoloration, the browner, the more muddy the fluid, the greater probably has been the change induced in the strangled parts by the congestion or inflammation resulting from the stricture. In some instances scarcely any fluid exists ; and then it becomes necessary to proceed with extreme caution in opening the sac, as the gut or omentum is applied closely to its inner wall. In such cases as these the sac is not unfrequently sufficiently translucent to enable the Surgeon to see its contents through it : and he should then open it opposite to the omentum, or to any small mass of fat which he may observe shining through it. The opening having once been made into the sac, may be extended by the introduction of a broad director (Fig. 676), upon which it is to be slit up to a sufficient extent to allow the examination of its contents.

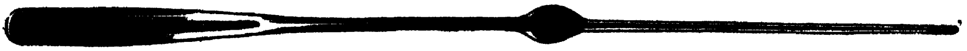


Fig. 676.—Broad and narrow Director on which the Sac may be divided.

**Division of the Stricture.**—The next point in the operation is the division of the stricture; and this requires considerable care, lest injury be done to the neighbouring parts of importance, or the gut be wounded. Vessels and structures in the vicinity of the stricture are avoided by dividing it in a proper direction, in accordance with ordinary anatomical considerations, which will be described when we come to speak of the special forms of rupture. All injury to the intestine is prevented by introducing the index finger of the left hand up to the seat of stricture, insinuating the finger-nail underneath it, and dividing the constriction by means of a hernia-knife, having a very limited cutting edge (Fig. 677). If a director be used to guide the knife, the intestine will be in considerable danger, as the instrument may be slid under that portion of it which lies beneath the stricture; or the tense gut, curling over the side of the groove, may come into contact with the edge of the knife. These accidents are prevented by using the finger as a director, and slipping the hernia-knife (which should not have quite so long a probe-point as those usually made) along the palmar surface of the finger, upon its flat side, (as represented in Fig. 678): the finger serves to keep the bowel out of the way, and detects any part that may be interposed between the edge of the knife and the stricture.

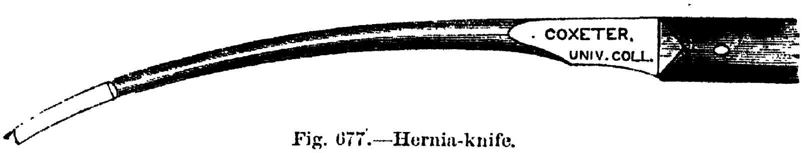


Fig. 677.—Hernia-knife.

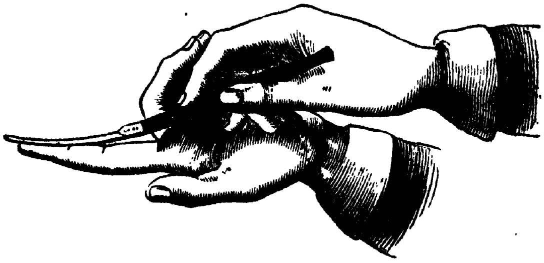


Fig. 678.—Mode of using the Hernia knife.

During the division of the stricture, the protruding portions of intestine must be protected from injury by the knife. The operator may spread his left hand over them in such a way that they cannot be touched by the edge of the instrument: or they may be protected by an attentive and careful assistant.

In some cases the stricture is so tight that it is at first almost impossible to get the edge of the nail underneath it. The Surgeon, will, however, generally succeed in doing so, by directing his assistant to draw down the coil of intestine, so as to loosen it, as it were, from underneath the stricture ; he will then usually succeed in passing his finger up in the middle of the coil, where the mesentery lies. So soon as the blunt end of the hernia-knife has been passed under the stricture, its sharp edge must be turned up, and the constriction divided in a proper direction, to a very limited extent, from the one-eighth to the quarter of an inch.

**Reduction.**—The intestine and omentum, having been examined, must be dealt with according to the condition in which they are found ; as will be described at pp. 640—645, Vol. II. If these structures be sufficiently healthy to admit of reduction, the intestine should first of all be replaced. This must be done by pushing it back with as much gentleness as possible, and chiefly by using the index-fingers. When it has slipped up into the abdomen, the omentum must be returned in the same way. In reducing the hernial protrusion, after the sac has been laid open, care should be taken that the margins of this are firmly held down by means of a pair of forceps ; lest it, together with its contents, be returned *en masse*, the stricture being undivided. After reduction, the Surgeon should pass his finger up into the canal through which the hernia has descended, and feel that all is clear. A suture or two should next be applied through the lips of the wound, with a few cross strips of plaster between them, a pad of lint laid over it, and a spica bandage to retain it all in proper position, and to prevent the protrusion of the hernia again during a fit of coughing or a muscular effort. I have, however, seen the pressure of the pad occasion so much venous hæmorrhage, by producing congestion of the venous tissues in the neighbourhood of the wound, as to require it to be laid aside, and the wound to be simply dressed. About the third or fourth day the sutures may be removed, and water-dressing applied. If inflammation or suppuration should set in, the part must be well poulticed ; and care should be taken to leave the most dependent aperture free, as otherwise the pus formed in the external incisions may flow back through the internal aperture into the peritoneal cavity, and occasion fatal inflammation. Indeed, I think it desirable that union of the lips of the wound after the operation for hernia should not take place by the first intention ; as it not unfrequently happens when this occurs, that the pus and other discharges, not finding a ready outlet, may either be diffused between the muscular planes of the abdominal wall, occasioning sloughing and abscess, or, returning into the peritoneal cavity, may excite inflammation of it—a result which I have more than once seen occur.

The result of the operation for strangulated hernia is greatly influenced by the age of the patient ; the result being very much more favourable in the earlier than in the later periods of life. Of 15 consecutive cases operated on at University College Hospital, of which 8 recovered and 7 died, the average age of the fatal cases was 28 years greater than that of the successful ones. Obesity, also, has a very unfavourable effect. The depth of the wound in fat people leads to an accumulation of drainage and exudative fluid from its loosely organised fatty walls, which decomposes readily, and soaking into the subperitoneal cellular tissue, gives rise to low and diffuse cellulitis with sloughing.

**After-Treatment.**—The patient should be kept quiet in bed ; a dry hot flannel laid over the abdomen, the leg on the affected side bent over a pillow, and from 30 to 40 ♏ of laudanum given. The bowels will probably act in the course of twenty-four hours ; should they not do so, a castor-oil and gruel enema may be thrown up. It is of very great importance not to administer any purgatives in these cases, and to take little heed of the bowels not acting, even for three or four days after the operation. If the mechanical obstacles have been removed they will be sure to recover their proper action ; though, in consequence of the gut having been severely constricted and almost wounded by the pressure of the stricture, it may require to be left quiet for a few days before it can recover its peristaltic action. The administration of purgatives, by still further irritating it, will increase the risk of inflammation in it, and will probably do much harm. The patient, of course, must be kept upon the simplest and most unirritating diet—indeed, he should only be allowed barley-water and ice for the first day or two, and afterwards some beef-tea ; but no solid food must be given till the bowels have acted, and all risk of peritonitis has passed.

ACCIDENTS AND MODIFICATIONS OF THE OPERATION.—The operation having been thus described, we have next to consider in detail certain accidents attending it, or modifications which may be required ; such as Peritonitis, the Management of the Intestine according to its conditions, the Management of Adhesions and of the Omentum, Wounds of the Intestine and of Arteries, Sloughing of the Sac, Artificial Anus, and Fæcal Fistula.

**Peritonitis after Operation.**—The great danger to be apprehended after operations for hernia is the supervention of *peritonitis.* This may have existed before the operation, may be impending at the time, or it may be occasioned, or at all events greatly increased, by the necessary wound of the peritoneum. Two distinct kinds of peritonitis commonly follow operations for hernia ; the active or acute, and the passive or latent.

*Acute Peritonitis* is commonly met with in strong and robust people, otherwise healthy, who are the subjects of the operation. It presents the ordinary symptoms of acute idiopathic inflammation of the abdomen ; there is tenderness of a diffused character, with lancinating pains. The patient lies on his back, with his knees drawn up, has an anxious countenance, a quick, hard pulse, a dry tongue, and much inflammatory fever ; the respiration is principally thoracic, and tympanites soon comes on. The bowels are usually constipated, though sometimes irritated. The *Treatment* of this form of herniary peritonitis is best conducted by the administration of opium, either alone or in combination with calomel. A pill containing gr. j of opium may be given every fourth or sixth hour. If the patient is young and strong, gr. j of calomel should be added, and leeches, followed by hot fomentations, applied to the abdomen, and the patient confined to barley-water, milk, and ice. When the inflammatory action is subdued, the constipation which is occasioned by it will be relieved without the necessity of administering any purgatives. The tympanites may best be removed by turpentine enemata, and any lurking tenderness by the application of blisters.

*Latent or Passive Peritonitis* appears to be of a diffused or erysipelatous character. It chiefly occurs in old people, or in weakly subjects, and is especially apt to follow upon inflammation of the omentum and its consequent suppuration ; or it may occur in consequence of the extension of diseased action from the cutaneous wound, and in other cases from the morbid condition induced by the strangulated gut. In hospital patients especially, in whom all disease is apt to assume a low character, this inflammation is peculiarly liable to occur. In some instances, it sets in without the appearance of any marked local symptoms of inflammation, such as pain or uneasiness in the abdomen ; but, two or three days after the operation, the patient becomes depressed, with a quick and weak pulse, an anxious countenance, a tumid and tympanitic abdomen, and rapid sinking of strength. In the majority of cases, however, some of the ordinary local signs of peritonitis are present. After death, the abdominal cavity will be found to contain a quantity of turbid serous fluid mixed with flakes of lymph ; in many instances in such quantity as to give it a puriform appearance, and not unfrequently matting together the coils of intestine. In the *Treatment*, it is necessary to support the patient, and in some instances even to administer stimulants, such as ammonia, the brandy-and-egg mixture, &c. Depleting measures of all kinds are quite inadmissible : and, indeed, the remedy that offers the most prospect of benefit to the patient is opium, in full doses, one grain being given every third or fourth hour until some effect is produced upon the constitution. Opium not only acts as an useful stimulant in these cases, but has a tendency to allay the increased vascular action. At the same time, a blister to the abdomen, dressed with mercurial ointment, may be advantageously employed ; and turpentine enemata may be administered, with the view of removing the tympanites, which is a source of much distress to the patient.

**Management of Congested Intestine.**—The condition in which the contents of the sac are found in a case of hernia, determines greatly the course which the Surgeon should pursue after the division of the stricture. Most frequently the intestine is deeply congested, being of a reddish purple, a claret, or chocolate colour. This congested state must not be confounded with gangrene of the part—a mistake which might happen if the Surgeon were to content himself with judging of its condition by the colour. However dark this may be, the gut cannot be said to be gangrenous so long as it is polished and firm, free from putrescent odour, and without a greenish tinge. In cases in which there is much doubt as to whether its vitality continues or not, it has been proposed to scarify its surface lightly with the point of a lancet. If blood flow from the punctures, this may be taken as a proof of the continuance of the vitality of the part. Such a procedure as this, however, is certainly attended by some degree of danger, and can seldom be required.

When the intestine is merely congested, however deeply this may be, the rule is, that it should be returned into the cavity of the abdomen in the hope of its ultimately recovering itself. This it will generally do if it have not been too much handled after the sac has been opened ; but in some cases it will slough a few days after it has been reduced, and, the fæces being discharged through the wound, a fæcal fistula will be formed ; this may happen as late as the eighth or tenth day after the operation.

**Management of Tightly Constricted Intestine.**—When the intestine has been very tightly nipped by a sharp-edged stricture, so that a deep sulcus or depression is left upon it, it seldom recovers itself, whether the whole of the coil of gut have been thus affected, or the constriction have been limited to a small portion of the diameter of the intestine. It is remarkable how very quickly changes which are incompatible with life may ensue in a portion of gut that has been very tightly strangulated. I have known a coil of intestine, that had been but eight hours strangulated before the operation was performed, so tightly constricted as not to regain its vitality after reduction (Fig. 679). In such cases the patient usually dies of peritonitis in the course of a few days, without the bowels having acted, all peristaltic motion having necessarily been annihilated at the injured point. On examination after death, the constricted intestine will be found to present all the appearances of *gangrene*, being of a black or ashy-grey colour, without having any flocculi of lymph deposited upon its surface, though these may be in abundance in the neighbouring parts. From the very unfavourable result of those cases in which there has been very tight nipping of the protruded bowel, a very cautious prognosis should be given; and, in reducing the gut after the division of the stricture, care should be taken not to push it far back into the abdomen, but to leave it near the inner ring; so that, in the event of its ultimately giving way, there may be less risk of feculent extravasation. In those cases in which the nipping has been very severe, the sulcus being distinctly marked, and the intestine excessively dark and congested, though not actually gangrenous, it would, I think, be better, after dividing the stricture, to leave the gut outside the ring than to return it; the reduction of intestine in this state being almost invariably followed by fatal peritonitis.

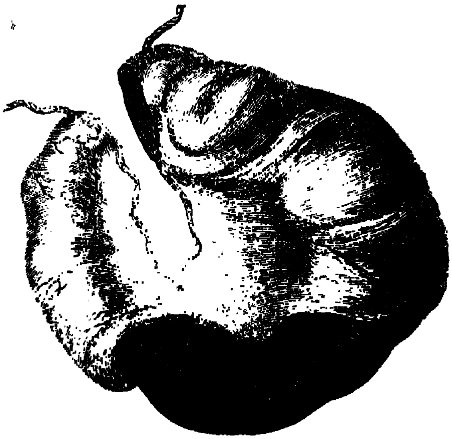


Fig. 679.—Gangrene of Intestine from Strangulation.

It is important to observe that although intestine, which has been so severely nipped as this, may not be able to recover its vitality, and will fall into a state of gangrene after being reduced, yet it does not, at the time of its exposure, present the characters of putrescence; there is no fetor, no green or pulpy appearance, no loss of polish, nor separation of peritoneum; it is simply of a dark purple or morone colour, and that it has been tightly nipped is evident from the sulcus upon it. There are no signs of gangrene, simply because sufficient time has not elapsed for putrefaction to set in. As, when a pile or nævus has been tied, though vitality be extinct in the part, which is swollen and purple, some time must elapse before signs of putrescence manifest themselves, so it may be with a strictured gut which may have lost its vitality; and it should be treated as mortified intestine, though there be no sign of putridity about it.

**Management of Gangrenous Intestine.**—When the intestine is actually gangrenous, the integuments covering the tumour will be infiltrated, brawny, and duskily congested, and the structures immediately overlying the sac matted together; the sac will contain fetid dark-coloured serum or pus; and the softened, lacerable, or pulpy look of the protruded part, its loss of lustre, and peculiar greenish-black or dark-grey colour, will cause the nature of the mischief to be readily recognised. In the majority of cases there will be much constitutional depression, and clammy skin, tympanitic abdomen, and brown or black tongue ; but in some instances I have known all these symptoms to be absent, and the condition of the patient to present no very unfavourable state. Some difference of opinion exists as to the proper line of practice to be adopted in such cases. Travers and Lawrence seem to think that the division of the stricture is unnecessary, or may even be injurious ; whilst Dupuytren, A. Cooper, and Key (with whom I concur), advise that it should be done : that the stricture should be divided in the usual way ; that a free incision should then be made into the protruded portion of bowel, which must be left unreduced, so as to allow the escape of fæces ; and the wound left open and covered by a poultice. In this way an artificial anus will necessarily be formed, through which the feculent matter finds exit. The gut in the vicinity of the stricture is retained *in situ* by masses of plastic matter, which prevent the peritoneal cavity from being opened. If the intestine should already have given way before the operation is performed, the stricture must be divided, and the part then left unreduced, care being taken to interfere as little as possible with any adhesions or connections lying inside the neck of the sac ; though I fully agree with Key, in thinking that the danger of disturbing them has been exaggerated.

When a small portion of the bowel only is gangrenous, the better plan is to return it just beyond the mouth of the sac, without laying it open ; but it should not be pushed any distance into the cavity of the abdomen ; the pressure of the surrounding parts will prevent extravasation. When the slough separates, it will probably be discharged into the cavity of the intestine ; and the aperture resulting will be closed by the adhesions that extend between its margin and the abdominal wall.

**Management of Adhesions.**—This varies according to the condition of the bowel, and the nature and situation of the bands. As has just been remarked, if gangrene be present, especial care must be taken not to disturb any connections that have been formed about the neck of the sac, and which constitute the most effectual barrier against feculent extravasation. When the adhesions are recent, consisting merely of plastic matter, in whatever situation they exist, they may readily be broken down with the finger or the handle of the scalpel, and the parts then returned. When of old standing, and dense, they must be dealt with according to their connections. Most frequently these adhesions occur in the shape of thickened bands, situated within and stretching across the neck of the sac. In other cases, they may be found either as filamentous bands, or as broad attachments connecting the sac with its contents, and perhaps tying these together. When of a narrow and constricted form, and more particularly when seated in the neck of the sac, or stretching like bridles across its interior, they may readily be divided by a probe-pointed bistoury, or the hernia-knife. If they consist of broad attachments, they may be dissected away, by a little careful manipulation, from the parts in the inside of the sac ; though, if the adhesions be very extensive and of old standing, it may sometimes be more prudent to dissect away that portion of the sac which is in connection with them, or even to leave them untouched, and the adherent intestine or omentum unreduced rather than to endeavour to separate them. They may, however, attach themselves in such situations that it becomes necessary to divide them; thus I have, in a case of congenital hernia, found it necessary to dissect away some very extensive and widely spread adhesions that had formed between the omentum and the testicle, and indeed had almost completely enveloped that organ.

*Internal Adhesions* between the omentum and intestine or mesentery occasionally exist, consisting usually of rather firm bands stretching across from one part to the other, sometimes connected with the inner wall of the sac, but in other cases confined to its contents. As these bands may constitute the real stricture, continuing to strangulate the gut after the division of the structures outside and in the neck of the sac, they must necessarily be divided. This operation requires great care, lest the neighbouring intestine be wounded. It is best done by passing a director underneath, and cutting the bands through with a probe-pointed bistoury; or if this cannot be done on account of their connections, they must be seized with forceps, and carefully dissected off the gut. In a case of large inguinal hernia, containing both gut and omentum, on which I operated some years ago, I found, after dividing the stricture, and taking hold of the omentum in order to push back the intestine, that this could not be reduced. On searching for the cause of difficulty, and drawing the mass well down, I found high up, in the part corresponding to the neck of the sac, a narrow band, like a piece of whipcord, stretching across from the omentum to the mesentery and firmly tying down the gut. On dissecting this carefully through, the constricted portion of intestine subjacent to it sprang up to its full diameter, all constriction being removed, and was then very readily reduced.

**Management of Omentum.**—The omentum may require to be treated in one of three ways: 1. It may be returned; 2. It may be left in the sac; 3. It may be cut off. The method of treatment must vary according to the state in which the omentum is found. If it be small in quantity, healthy in character though congested, and apparently recently protruded, not having undergone those changes that occur in it when it has been a long time in a hernial sac, it should be reduced after the intestine has been put back.

If, however, its mass be very large, if it be hypertrophied, indurated, or otherwise altered in structure, or if it be closely adherent to the sac, at the same time that it is congested, Surgeons are agreed that it should not be returned into the abdominal cavity; as inflammation of it, *Epiploitis,* will probably set in and terminate fatally with effusion into the peritoneal sac. So also, if the omentum be in large quantity, and have become inflamed in the sac, it should not be returned; as the inflammation in it is very apt to run on to a kind of sloughy condition of the whole mass. If gangrenous, it should certainly not be reduced. When simply hypertrophied and adherent to the sac, but without evidence of inflammation, it may be left in the sac; but, in many of the cases of hypertrophied, and in all cases of inflamed or gangrenous omentum, the best practice consists in cutting off the mass, as recommended by Sir A. Cooper and Lawrence. If it be left in the sac, inflammation or sloughing of it will occur, and the patient can derive no corresponding advantage to the danger he will consequently run. *Excision* of the mass may be done in two ways, either by seizing and cutting it off at a level with the external ring, or by first inclosing the neck of the mass in a small whipcord ligature, and then cutting it off below this. If the first method be employed, the arteries of the stump, which are sometimes rather numerous, are apt to bleed freely: they must be tied singly by fine ligatures, which should be left hanging out of the wound. There is often, however, a tendency to the retraction of the stump of the omentum into the abdominal cavity; in which case the ligatures, dropping into the peritoneum, and acting as setons, may become sources of great irritation: in order to prevent this, the better plan is to knot them together, and to fix their ends by a piece of plaster upon the forepart of the abdomen. The second plan consists in drawing down the mass of omentum, passing a strong double whipcord ligature through its neck, tying this securely on each side, and then cutting off the whole of the mass below the ligature. I have for many years employed it with excellent effect, and indeed now generally prefer it to the method just described, over which it possesses the advantages of freedom from hæmorrhage and impossibility of deep retraction of the cut edge of the omentum into the cavity of the abdomen, provided moderate traction be kept up in the ligatures. The constricted stump of omentum sloughs away in a few days, and separates with the ligature. When this practice is adopted, the wound should not be closed, but must be lightly poulticed. Should it be preferred to do this operation antiseptically, the omentum may be tied with catgut ligatures cut short, a drainage-tube introduced, and the usual antiseptic dressings applied. The quantity of omentum that is cut off varies considerably; the mass removed usually weighs from four to six ounces, but in some instances it may amount to a pound or more.

*Sacs* or *Apertures* are occasionally formed in the omentum, in which a knuckle of intestine may become enveloped, or by the margins of which it may be strangulated. These envelopes of omentum around the gut, which have been especially described by P. Hewett, may occur in all kinds of hernia, at least in the inguinal, the femoral, and the umbilical, and sometimes acquire a large size, completely shutting in the gut. They appear to be formed in some cases at least by the adhesion of the opposite edges of floating layers of omentum around a piece of intestine, which thus becomes included. It is of importance to bear in mind the possibility of their existence, and in all cases to unravel the omentum before removing it, lest it contain a knuckle of intestine, which might be wounded in the operation.

*Cysts*, usually containing pellucid serous fluid, straw-coloured or reddened, though sometimes they are filled with blood, are occasionally met with in the omentum. They appear to be formed in the same way as the sacs containing intestine just described, except that they are inclosed on all sides, their serous contents being merely exudations from the peritoneal lining of the cyst. They are globular, elastic, and closely resemble in form a knuckle of intestine, occasioning not a little embarrassment to the Surgeon: by a careful examination and unravelling, however, of the omentum, their true nature will be made out; their fluid contents may then be discharged, and the omentum dealt with according to the rules already given.

**Wounds of the Intestine** may accidentally occur at two periods of the operation; either from the Surgeon cutting too freely down upon the sac, and opening this before he is aware of what he is about; or else, at the time of the division of the stricture, from a portion of the gut which lies beneath it getting into the way of the edge of the knife, and being nicked by it. The first kind of accident can only happen from a certain degree of carelessness; but it is not always so easy to avoid wounding the gut, when the stricture is so tight that the finger-nail cannot be slipped under it as a guide to the hernia-knife. In cases of this kind, a very narrow director must be used; and this is a most dangerous instrument, as, in passing it deeply out of sight under the tight stricture, a small portion of the gut may curl up over its side into the groove, and thus become notched by the knife as this is slid along it. This accident has happened to the best and most careful Surgeons. Lawrence relates two cases that occurred to him; and Sir A. Cooper, Cloquet, Jobert, and Liston have all met with it. It may be known to have occurred by the bubbling up of a small quantity of flatus and liquid fæces from the bottom of the incision. The *Treatment* of a wound of the gut must depend upon its size. When it is very small, rather resembling a puncture than a cut, the practice recommended by Sir A. Cooper should be adopted; viz., to seize the margins of the incision with a pair of forceps, and to tie a fine silk thread tightly round them, the ends of which should then be cut off, and the gut returned into the abdominal cavity. Such a proceeding as this does not appear to give rise to much, if to any, increase of danger. In a case that occurred to me many years ago at the Hospital, in which, owing to the excessive tightness of the stricture, a very narrow director only could be passed under it, the gut immediately above it was notched and opened by a kind of punctured wound; this was tied up in the way mentioned, and after the death of the patient, which took place on the fourth day after the operation from gangrene of the strangulated portion of bowel, the silk ligature was found to be completely enveloped in a plug of plastic matter. If the wound be of larger size, it must be closed by the glovers' stitch.

**Wound of one of the Arteries** in the neighbourhood of the sac may occur during the division of the stricture, either in consequence of some anomaly in the distribution of the vessel, or from the Surgeon dividing the parts in a wrong direction. This accident usually happens to the epigastric or to the obturator artery; and Lawrence has collected fourteen recorded cases in which it occurred. The result in these has been very various; in some the patients have died; in others, after much loss of blood, and consequent faintness, the bleeding ceased spontaneously. The proper *Treatment* would certainly consist in cutting down upon and securing the bleeding vessel. In the event of the Surgeon operating on a case of hernia, without having been able previously to satisfy himself as to its precise character, or if from any cause, in dividing the stricture, he have reason to dread the proximity of an artery, he may safely and readily divide the constriction with a knife that would not easily cut an artery; and he will find, if he blunt the edge of his hernia-knife by drawing it over the back of the scalpel, that it will still be keen enough to relieve the strangulation, whilst it will push before it any artery that may happen to be in the way.

**Sloughing of the Sac** is of rare occurrence, and, when it happens, is commonly attended by fatal results ; it is not, however, necessarily so. It has twice happened in my practice ; and in both cases the patient recovered. In an old woman on whom I operated for femoral hernia of very large size, the sac sloughed away, exposing nearly the whole of Scarpa's triangle with almost as much distinctness as if it had been dissected ; but, although in much danger for a time from an acute attack of peritonitis, she ultimately recovered.

**Artificial Anus and Fæcal Fistula.**—When an aperture exists in the bowel by which the whole of the intestinal contents escape externally, the condition is denominated an *artificial anus.* When but a small portion so escapes, the greater part finding its way through the natural anus, a *fæcal fistula* is said to exist. The quantity of feculent discharge necessarily depends upon the extent of destruction of the intestinal coats ; and its character on the part of the gut that is injured. The escape takes place involuntarily, and is usually continuous.

This condition may occur in several ways. Thus the gut may be accidentally wounded during the operation, and the fæces may afterwards continue to be discharged through the aperture so made ; or it may have been gangrenous, and have given way into the sac before the operation ; or the Surgeon may have intentionally laid open a gangrenous portion of intestine, so as to facilitate the escape of the fæces. In some cases in which the bowel has been severely nipped, and is dark and congested, though it have not actually fallen into a state of gangrene, it may not be able to recover itself after its return into the abdominal cavity, but will give way in the course of three, four, six, or even ten days after the operation. In these cases, a small quantity of feculent matter is first observed in the dressings ; and gradually a greater discharge appears, until at last the fistulous opening is completely established. In such cases, it is of importance to observe that, although the bowel gives way within the peritoneal cavity, the fæces do not become extravasated into this, but escape externally. This important circumstance is owing to the fact of the portion of the bowel that is nipped losing its peristaltic action, and consequently remaining where it is put back ; the parts in the neighbourhood inflaming, throwing out lymph, and becoming consolidated to each other and to the parietal peritoneum, so as to include the gangrenous portion of the gut, and completely to circumscribe it. It is consequently of great importance, in cases of this kind, not in any way to disturb the adhesions that have formed between the sides of the aperture in the gut and the neck of the sac.

The *Pathology of Artificial Anus* is commonly as follows. The edges of the aperture in the gut are glued by plastic matter to the abdominal wall ; and whether the whole or a portion only of the calibre of the intestine be destroyed, the apertures of the upper and lower end, though at first lying almost in a continuous line, soon unite at a more or less acute angle. These are at first similar in size, and present no material differences in shape or appearance : as the disease becomes more chronic, they gradually alter in their characters ; the lower aperture, being no longer used for the transmission of fæces, gradually becomes narrower, until at last it may be almost completely obliterated; whilst the upper portion of intestine becomes dilated in consequence of there being usually some slight obstruction to the outward passage of the fæces. The mesenteric portion, opposite the aperture, becomes drawn out into a kind of prolongation or spur, the full importance of which was first pointed out by Dupuytren. This spur-like process projects between the two apertures, and, being deflected by the passage of the fæces, has at last a tendency to act as a kind of valve, and thus to occlude the orifice into the lower portion of the gut. The integuments in the neighbourhood of such an aperture as this usually become irritated, inflamed, and excoriated, from the constant passage of the fæces over them. In some cases, the mucous membrane lining the edges becomes everted, and pouting; and, in others, a true prolapse takes place, large portions of the membrane protruding. An artificial anus fully formed in this way never undergoes spontaneous cure. Besides this, which is the ordinary form of artificial anus, we must, I think, recognise at least two other varieties, both of which I have met in practice. In one of these, the angle formed by the gut is adherent to the upper extremity of the sac which has been returned, and thus lies at some distance from the surface, so that the fæcal matter traverses a long canal before it reaches the external aperture. In the other variety the angle of the gut is fixed at a higher point within the abdomen, and the fæces find their way out through a channel bounded by agglutinated coils of intestine and layers of lymph. In both of these forms, there is a considerable distance between the external opening and the aperture in the gut. Thus, then, there are three forms of artificial anus, differing from one another according to the situation of the angle of the gut in relation to the external opening and to its connections.

When a *Fæcal Fistula* has formed, the condition of parts is somewhat different. The aperture in the intestine consists of merely a small perforation in its coats, unattended by any considerable loss of substance, through which a quantity of thin fluid and feculent matter exudes, giving rise to a good deal of irritation of neighbouring structures. In some cases, there are several apertures communicating with the gut, and extending through the skin. Fistulous openings of this kind not unfrequently undergo spontaneous cure after existing for a few weeks or months.

*Treatment.*—If the aperture be merely a small one, with a narrow fistula leading into the gut, the chief inconvenience suffered by the patient often arises from the irritation of the skin around the opening by the continued moisture of the feculent matter. In such cases the skin should be protected by means of zinc ointment, spread on lint; and the patient should wear a pad to restrain the discharge. By the pressure of this pad the aperture may sometimes be made to close. In other cases, the occasional application of the galvanic cautery or of a red-hot wire will induce contraction of its edges; and in other instances, again, a plastic operation of some kind may be required. But I confess I have not usually seen much advantage result from such operations, which are often followed by erysipelas. As the existence of an artificial anus, by interfering with nutrition, commonly gives rise to considerable emaciation, it becomes necessary to support the patient's strength by a sufficient quantity of good and nourishing food; this is of greater consequence the higher the fistula is, as the interference with the earlier stages of the digestive process, and the loss of nutritive material by the discharge of the chyme, is proportionally great. Spontaneous cure will occasionally take place, even though a perfect artificial anus exist. In a case under my care at the Hospital, a whole knuckle of intestine was gangrenous, and sloughed away, leaving an artificial anus, which discharged the greater part of the intestinal contents, but gradually contracted and closed without any local application or treatment beyond attention to cleanliness.

If the aperture become a permanent artificial anus, surgical means must, if possible, be adopted in order to effect a cure. In accomplishing this, two important indications have to be fulfilled: the first is to diminish or destroy the projecting valvular or spur-like process, and thus to re-establish the continuity of the canal; and, after this has been done, the external wound may be closed, by paring its edges, and bringing them together with hare-lip pins.

The first object is best accomplished by Dupuytren's *enterotome* (Fig. 680); this consists of an instrument something like a pair of scissors, with blunt but serrated blades, which may be brought together by acting upon a screw that traverses its handle. One blade of the instrument (*a*) is passed into the upper, the other (*b*) into the lower portion of the intestine; they are then approximated slowly, and fixed by means of the screw in such a way as to compress on each side the spur-like process (Fig. 681). Very gradually, day by day, this screw is tightened so as to induce sloughing of this projection, and cohesion of its serous surfaces. As this action goes on, the irritation caused by the instrument will occasion plastic matter to be thrown out in the angle formed by the intestine, so that the peritoneum and mesentery become consolidated, and all opening into the peritoneal cavity is avoided. Should the spur-like process be accidentally cut through before the lymph is thrown out in sufficient quantity, the peritoneum would be opened, and death would probably ensue; hence the necessity for caution in this procedure. So soon as the blades of the

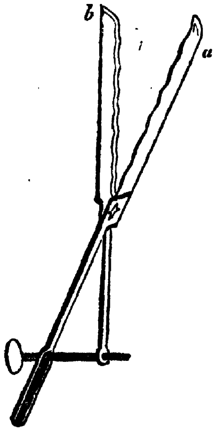


Fig. 680.—Dupuytren s Enterotome.

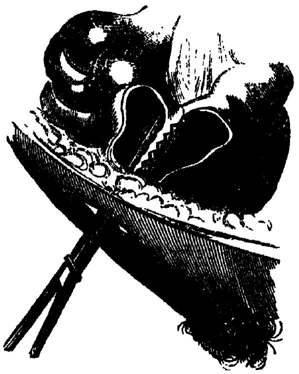


Fig. 681.—Enterotome applied.

instrument have come into contact, and the spur-like process has consequently sloughed away, the great obstacle to the closure of the artificial anus will be removed ; and the continuity of the canal being thus re-established, its lips may be pared and brought together by hare-lip pins and sutures. In some cases, from the length of time that has elapsed—many years, possibly —the fistula continues permanently patent, and no treatment is available for its closure. Its existence is not incompatible with good general health. I have had two cases under my constant observation, in one of which, that of a woman about fifty years of age, the whole of the intestinal contents have been discharged for four years through an aperture of the umbilicus, in consequence of the sloughing away of a large coil of intestine in an umbilical hernia ; and another case is a lady more than eighty, who has for upwards of thirty years had a fæcal fistula in the right groin, consequent on an operation for femoral hernia.

OPERATION WITHOUT OPENING THE SAC.—The possibility of removing the stricture in strangulated hernia without laying the sac open, naturally suggested itself when it was known that in many cases the stricture was seated in the tendinous and areolar tissues outside the neck of the sac, and that, when these were divided, the protrusion was readily reduced. This operation was performed by Petit as long ago as 1718, but was seldom practised until it was revived of late years by Aston Key and Luke. The great advantage sought to be gained by this operation is that, as the peritoneum is not interfered with nor its cavity opened, the risk from peritonitis will be proportionately lessened. The wound made by the operation being altogether superficial, and the sac not opened, its risk has been compared to that of the taxis, with the addition of that which would result from a superficial wound. This argument would be conclusive in favour of the operation without opening the sac, if it could be shown that, in all cases of strangulated hernia, peritonitis is occasioned by interfering with the peritoneal cavity ; it must, however, be admitted, even by the keenest advocates of Petit's operation, that this is not the case. But there is this additional element of risk : that it is the taxis practised on a hernia that has been so tightly strangled that reduction is impossible without operation, and in which, consequently, the parts that constitute the hernial protrusion are infinitely more congested, inflamed, and deteriorated in structure than are those in which reduction by the simple taxis without operation to divide the stricture is possible. In many instances the inflammation exists before any operation is performed, being evidently produced by the stricture of and consequent injury to the gut. But it cannot with fairness be argued that, though the peritonitis may exist before the operation, the incision of the peritoneal cavity does not increase it ; even in healthy persons, laying open the abdomen, handling the gut and omentum, and pushing the fingers into the peritoneal sac, would always be followed by intense, often by fatal, peritonitis. It is only reasonable to believe that the same procedures in an already inflamed peritoneum would be followed by equally disastrous results.

That the opening made into the cavity of the abdomen in reality adds to the frequency of the peritonitis, cannot, I think, be doubted by any Surgeon. It not unfrequently happens in strangulated hernia, that no sign of peritoneal inflammation sets in until one or two days after the operation is performed; and then it occurs evidently as the result of this procedure. That the fatality of the peritonitis, even if existing before any operation be practised, must be greatly increased by interference with the serous sac, is evident from the fact already mentioned, that death very rarely occurs (not more than once in many hundred cases) after the reduction of a strangulated hernia by the taxis. Fully admitting, therefore, that in many cases the peritonitis exists before the operation, and is occasioned by causes independent of it; it is, I think, impossible to deny that the inflammation is frequently directly occasioned by opening the peritoneal cavity, and handling the viscera; and that, when already existing, its fatality must be greatly increased by this procedure. In fact, there are two causes for peritonitis in cases of operated strangulated hernia—viz., the constriction of the stricture, and the wound of the peritoneum. That form of peritonitis which arises from the pressure of the stricture is equally liable to happen, whether Petit's operation or that by opening the sac be practised, and often precedes the operation; whilst the peritonitis which arises from wound of the serous membrane does not occur in Petit's operation, but is necessarily confined to that in which the sac is opened.

There are, however, two objections that may be urged against Petit's operation with more justice than that it does not tend to prevent the occurrence of peritonitis. The first is that, if the intestine be not seen, it may sometimes be returned in a gangrenous condition; and the second, that the gut may possibly be returned still strangled by bands of adhesion, or by inclusion in an omental aperture. With regard to the first objection, it may be stated that, if the intestine be in a gangrenous state, there will usually be some evidence of this, either in the change that has taken place in the general symptoms of the patient, or in the condition of the sac and its coverings, which will enable the Surgeon to guess at the condition of the enclosed parts, and will of course induce him to expose them fully and examine them thoroughly. This objection, however, cannot apply to those cases in which the strangulation has only existed for a time that would be insufficient to allow the occurrence of gangrene, and does not therefore oppose the performance of Petit's operation in recent cases of strangulation. With regard to the occurrence of internal strangulation, it is excessively rare; and when it does occur, it still more rarely happens, whether the strangulation be effected by bands of adhesion or by an aperture in the omentum, that the parts can be returned without opening the sac, adhesions usually existing also between this structure and its contents. But the best answer to the objections against the operation without opening the sac, are the results that have followed this practice. Luke, who has had great experience on this subject, states that he has operated in 84 cases of hernia. In 25 of these the sac was opened; in 59 the sac remained unopened. Of the 25 in which it was opened, 8 died; whilst, of the 59 in which Petit's operation was performed, only 7 died. If to Luke's cases we add those reported by N. Ward, we shall find 36 deaths in 153 cases of Petit's operation. That the ordinary operation, indeed, of opening the sac, is an exceedingly fatal one, is well known to all hospital Surgeons, and is fully proved by surgical statistics. Of 77 operations for hernia, reported by Sir A. Cooper, 36 proved fatal; and of 545 cases recorded in the Journals, and collected by Turner, 260 are reported to have died. The result, therefore, of Luke's operations is most favourable, when contrasted with those in which the sac was opened.

The operation without opening the sac may be practised in all forms of hernia, but is much more readily done in some varieties of the disease than in others. It is especially applicable in cases of femoral hernia, in which the stricture is commonly outside the sac, as will be mentioned when speaking of that form of the disease. Of 31 cases of femoral hernia, operated on by Luke, the sac required to be opened in 7 only. In inguinal hernia it is not so easy to perform Petit's operation; indeed, in the majority of cases the Surgeon will fail to remove the stricture in this way. This is owing to the constriction being usually seated in the neck of the sac, and is especially observable in congenital hernia. Of 20 inguinal herniæ operated on by Luke, the sac required to be opened in 13 instances.

For the various reasons that have been mentioned, I am decidedly of opinion that this operation should always be attempted, in preference to the ordinary one of opening the sac, in those cases in which the hernia, not having been long strangulated, presents no sign of the occurrence of gangrene in it, and more especially when it is femoral or umbilical. Even if the Surgeon fail in completing Petit's operation, in consequence of the incorporation of the stricture in the neck of the sac, or the constriction of this part, no harm can have resulted; for the sac, after being exposed, may at any time be opened in the ordinary way, and the operation completed by dividing the stricture from within.

When the hernia is of large size and irreducible, it is of especial importance to avoid opening the sac. If it be opened, the contents will inflame, and fatal peritonitis commonly ensues.. In these cases, as Luke has pointed out, it rarely happens that the old inherent parts are seriously strangulated, but the whole mischief seems to be occasioned and to be received by the new protrusion that has taken place, and that gives rise to the tension; and if this can be liberated and reduced, the Surgeon has done all that need be accomplished. The evidence of the reduction of the recent protrusion, although the old adherent and irreducible hernia be left, is usually sufficiently obvious; the portion of gut returning with a slip and a gurgle, with considerable diminution in the general tension of the tumour.

**Operation.**—With regard to the mode of performing Petit's operation little need be said here, as it is precisely identical with the steps of the other operation up to the period of the exposure of the sac; except that, when it is not intended to open this, the incisions should be carried more directly over its neck. The stricture, if situated outside the sac, will then be found either in some of the tendinous structures surrounding it, or else in the subserous areolar tissue lying upon it. After the division of the constricting bands in this situation, by means of a probe-pointed knife carried underneath them, or by dissecting down upon them, an attempt at the taxis may be made by compressing the tumour in the usual way, at the same time that its neck is steadied by the fingers of the left hand. If the contents can be reduced, the incision in the superficial structures is brought together by a few strips of plaster, over which a pad and bandage may be applied. Should peritonitis come on, as the result of the strangulation, it must be treated in the usual way. If, after the Surgeon has fairly divided all the structures outside the sac, he find still that the return of the hernia is prevented by some constriction in its neck, it will be necessary to lay this open and divide the constriction in the usual way.

**Reduction in Mass.**—The reduction of the hernia in mass consists in the return of the sac and its contents into the abdomen still in a state of strangulation. When it is said that the parts are returned into the abdomen, it must not be understood that they are pushed back into its cavity, but that the external protrusion is caused to disappear by being pushed into the subserous areolar tissue behind and underneath the parietal peritoneum, between it and the abdominal muscles. This remarkable accident, which was first described by the French Surgeons of the last century, received but little notice from practitioners in this country until attention was drawn to it by Luke, by whom its pathology has been carefully studied. Birkett, who has also investigated this condition with much care, is of opinion that the sac is not torn from its connections in the scrotum or canal, and pushed back, but that it is ruptured, usually at its posterior part at its neck, and that thus the contents of the sac are forced through this rent into the subperitoneal areolar tissue; whilst the mouth of the sac, still constricting the hernia, and thus keeping it in a state of strangulation, is pushed back from the internal ring. It appears to me that both explanations are correct, and that we must admit two forms of reduction in mass; the sac being pushed back intact in a state of strangulation, in one form, as described by Luke; whilst in the other, as observed by Birkett, the sac is ruptured, and the hernia, strangulated by the displaced mouth of the sac, is forced out through the rent.

*Causes.*—The reduction in mass has been far more frequently observed in cases of inguinal than in those of any of the other varieties of hernia. It has been met with in femoral herniæ, but very rarely, and, so far as I know, not in any other form of the disease. This comparative frequency of its occurrence in inguinal herniæ is doubtless due to their large size, and loose areolar connections. The accident has more often occurred from the patient's own efforts at reducing a strangulated hernia, than from those of the Surgeon. It is a remarkable fact that, in most of the instances in which it has occurred, only a very slight degree of force appears to have been employed in the reduction of the tumour; and the accident would seem to have resulted from the adhesions between the sac and the neighbouring parts being much weaker than natural, so that a moderate degree of force caused the whole to slip through the canal. It may, however, occur from the Surgeon's efforts, if these be too forcible or long continued.

*Symptoms.*—The symptoms indicative of this accident are constitutional and local. The constitutional symptoms consist in a continuance of those that are indicative of the existence of strangulation, notwithstanding the disappearance of the tumour. The vomiting and constipation persisting, the patient speedily becomes much depressed in strength, being seized with hiccup and prostration of all vital power; signs of gangrene then evince themselves within the sac; and death ensues.

An examination of the parts in hernia will usually enable the Surgeon to recognise the nature of the accident; he will ascertain that a tumour had previously existed, and will learn from a description of its general characters, and the symptoms occasioned by it, that it was in all probability a strangulated rupture. He will then find, on examining the part, that there is a total absence of all that fulness which is occasioned by the presence of the sac, even after its contents only have been reduced; the sac, in such cases, always giving rise to a feeling of fulness and roundness in the part. He will, on the contrary, find that the abdominal ring is peculiarly and very distinctly open; it is much larger than usual, and somewhat rounded. On pushing the finger into the canal, this will be felt quite empty; but in some cases, on deep pressure with the finger, especially when the patient stands up or coughs, a rounded tumour may be indistinctly felt behind the ordinary seat of the hernia. In many cases, however, the most careful manual examination will fail to detect any prominence of this kind.

*Treatment.*—If, after careful examination of such a case as this, in which the symptoms of strangulation continue, the Surgeon learn by the previous history that a tumour has existed, but that it has suddenly gone up; and further, if he find that the seat of the supposed hernia presents the negative evidence that has just been described, it will then be necessary for him to push his inquiries a step further by an exploratory incision. Such an incision as this may first be used as a simple means of diagnosis, and, as it does not penetrate the peritoneal cavity, there is no danger attending it; and if the hernia be found, it will serve the purpose of the ordinary incision required in the operation, and may be used for the relief of the strangulation. The first incision should be made so as to expose the abdominal ring; if this be found peculiarly round and open, it would increase the probability of the existence of the condition sought for. The inguinal canal must next be laid open, and the parts contained within it carefully examined. If no appearance of hernial sac be found, but the cord be distinctly and clearly seen, still further presumptive evidence will be afforded of the reduction having been effected in mass; for, if the hernia have been put back in the usual way, the sac will necessarily be left in the canal, and will preserve its usual relations to the cord. This supposition will be strengthened almost to a certainty if it be found that the "condensed cellular capsule immediately investing the sac," as it is termed by Luke—in other words, the condensed and laminated subserous areolar tissue—has been left in the canal. An opening made into this will, as that Surgeon observes, allow the finger to be brought into contact with the hernial tumour itself. Should, however, this condensed areolar tissue not be found, it must not be concluded that no hernia is present, inasmuch as this investment may have been accidentally absent. The finger should then be passed into the internal ring, which will probably be found open, and should be carried from side to side; the tumour, if present, will be detected lying externally to the peritoneum behind the abdominal wall. When found, it must be brought down into the canal by enlarging the ring; it must then be opened, its contents examined, and the stricture in its neck divided. The intestine that has been so strangled must be dealt with in accordance with the rules already laid down. If the tumour cannot be readily brought down so as to admit of an examination of it and its contents, the patient should be desired to make some propulsive efforts, so as to cause it to protrude. If it still do not come down, it must be opened, and the stricture cautiously divided within the abdomen with a sheathed bistoury.

**Treatment of Strangulated Hernia by Aspiration.**—This operation, in which it is attempted to render a strangulated hernia reducible by withdrawing its gaseous and fluid contents by means of the pneumatic aspirator, was introduced into practice by Dieulafoy, and is thus performed :—An aspirator of the form represented in Fig. 660, page 571, is to be preferred, and the needle must not exceed $\frac{1}{25}$ inch in diameter. The aspirator having been proved to be in working order, and the needle clear, a vacuum is made by withdrawing the piston. A few drops of water may be left in the bottom of the piston, so that gas may be recognised as soon as it enters. The needle is now introduced into that part of the tumour, where, from resonance on percussion, or elastic feel, the gut is supposed to lie, and as soon as its eye is covered the vacuum is turned on. The needle must now be carefully and steadily pushed onwards. If there be fluid in the sac this will rise into the syringe, and as soon as it ceases to flow, the needle must be again carefully pushed onwards, until, from the appearance of gas or fæcal matter in the syringe, it is known that the gut is reached. The needle must be held steadily and pushed in one direction only, as any lateral movement would tend to scratch or tear the gut. The gas may be sufficient in quantity to abolish the vacuum, and if this occur, the cock must be turned, the syringe emptied, and a fresh vacuum made. If one puncture fails to diminish the bulk of the tumour, the needle must be withdrawn and inserted at a fresh spot, and this may be repeated two or three times. If the needle become plugged, it is better to abandon the operation at once, as further attempts would probably meet with no better success. After the operation taxis may be immediately employed, and if it fail the ordinary operation must be performed. Further evidence is required to establish the true value of aspiration, but it has been performed sufficiently often to show that if needles of the proper size be used carefully, it is almost, if not absolutely, innocuous. Dieulafoy records 27 cases, 20 of which were successful, reduction of the gut by taxis following the operation. In the remaining 7 it was harmless, and of these 3 died and 4 recovered, after the ordinary operation for hernia. At University College Hospital aspiration has been tried 7 times. In 1 case only was it followed by reduction ; in 1 the fluid from the sac only was withdrawn, yet the impulse returned and the patient recovered, though the hernia remained unreduced ; in 4 it failed entirely, and the ordinary operation was performed in 3 cases successfully. In the fatal case two days after the operation the punctures could not be found at the post-mortem examination. In the remaining case the patient was moribund at the time, and died a few minutes after the operation. At the post-mortem no gas or fluid could be squeezed from the punctures in the gut. It seems, therefore, that the danger of fæcal extravasation is very small, although it is said to have occurred. The operation may fairly be tried in suitable cases, especially when the hernia is resonant on percussion, and only recently strangulated. It would be unwise to attempt it when from the duration of the strangulation inflammation or gangrene of the gut might be suspected.

# CHAPTER LXIII.

## SPECIAL HERNIÆ.

### INGUINAL HERNIA.

By **Inguinal Hernia** is meant that protrusion which occupies the whole or a portion of the inguinal canal, and when fully formed, passes out of the external abdominal ring into the scrotum. Many varieties of this hernia are recognised by Surgeons. Thus it is said to be *Complete,* when it passes out of the external ring; *Incomplete,* or *Interstitial,* so long as it is contained within the canal; *Oblique,* when it occupies the whole course of the canal; *Direct,* when it passes forwards through a limited extent of it; *Congenital,* when it lies in the sac of the tunica vaginalis; and *Encysted,* or *Infantile,* when it lies behind this. Inguinal herniæ constitute the commonest species of rupture, and would be much more frequent than they are, were it not for the obliquity of the canal, and the manner in which its sides are applied to one another, and closely overlap the spermatic cord. They occur with most readiness in those cases in which the canal is short and the apertures wide. Although these herniæ are commonly incomplete in their early stages, it is seldom that they come under the observation of the Surgeon until the protrusion has passed beyond the abdominal ring.

Oblique Inguinal Hernia, often called *External,* on account of its relation to the epigastric artery, passes through the whole length of the canal, from one ring to the other; and usually protrudes through the external one, constituting one of the forms of **Scrotal Hernia.**

**Coverings.**—As it passes along the canal, it necessarily receives the same investments that the spermatic cord does; although these are often greatly modified by being elongated, hypertrophied, and otherwise altered in appearance. If we regard the inguinal canal as consisting of a series of invaginations of the different layers of the abdominal parietes, the outermost being the skin, and the innermost the fascia transversalis, with the peritoneum applied to this, it is easy to understand how the hernia in its descent has these prolongations drawn over it, thus becoming successively invested with the same coverings as the spermatic cord. Thus it first pushes before it that portion of the peritoneum which lies in a fossa just external to the epigastric vessels; it next receives an investment from the subperitoneal fat, which, uniting with the fascia transversalis, constitutes the *fascia propria* of the sac; as it passes under the internal oblique, it receives some of the fibres of this muscle, in the shape of the cremasteric fascia; and, lastly, when it reaches the external abdominal ring, which it greatly distends and renders round and open, it becomes covered by the intercolumnar fascia, receiving also a partial investment around its neck from some of the expanded and thickened fibrous bands that lie near the ring, and which are always most marked upon its outer side.

**Relations.**—The relations of the spermatic cord and testes, and of the epigastric artery, to an inguinal hernia, are of great importance. The *spermatic cord* will almost invariably be found to be situated behind or rather underneath the oblique inguinal hernia; and the *testis* will be found to lie at its lower and back part, where it may always be distinctly felt. In some cases the elements of the spermatic cord become separated, the vas deferens lying on one side, and the spermatic vessels on the other. In other rare cases, an instance of which there is in a preparation in the University College Museum, the hernia lies behind the cord and has the testis in front. In other cases, again, it may happen that the elements of the cord are all separately spread out on the forepart of the hernial tumour. The *epigastric artery* has the same relations to the oblique inguinal hernia that it has to the spermatic cord, lying to the inner side of and behind its neck. The pressure of large and old inguinal herniæ has, however, a tendency to modify somewhat the relations of this vessel. By distending the rings, and dragging the posterior wall of the canal downwards and inwards, they shorten the canal, and cause a great deflexion of the artery from its natural course, which is changed from an oblique direction to one curved downwards and inwards, under the outer edge of the rectus muscle.

Direct Inguinal Hernia.—This does not pass out like the oblique through the internal abdominal ring, but pushes forwards through a triangular space, which is bounded by the epigastric artery on the outer side, the edge of the rectus on the inner, and the crural arch at its base; through this the hernial tumour protrudes, pushing before it or rupturing the posterior wall of the inguinal canal.

**Coverings.**—These vary according to the length of the canal that the hernia traverses, and the portion of the posterior wall through which it protrudes. In fact, there are at least two distinct forms of direct inguinal hernia, which differ according as they are situated above or below the remains of the umbilical artery. One, the most common variety, is situated below the cord-like remains of this vessel, between it and the outer edge of the rectus. The other, which is of less frequent occurrence, is situated above this vessel, between it and the epigastric artery.

In that form of direct inguinal hernia, which lies *below the umbilical artery*, the protrusion takes place through that part of the posterior wall of the inguinal canal which is situated almost behind and opposite to the external ring. In this situation, the investments successively received by the hernia are, first, the peritoneum, the subperitoneal fat, and the fascia transversalis; it then comes into contact with the conjoined tendons of the internal oblique and transversalis muscles, which it may either rupture or push before it, thinned out and expanded. Most frequently these are ruptured, constituting a partial investment to the protrusion, which is most evident on the innermost part of the sac, that which is nearest the mesial line. As the hernia passes through the external abdominal ring, it receives from it the intercolumnar fascia and fibres, and lastly is invested by the common fascia and integuments.

In the direct inguinal hernia which lies *above the umbilical artery*, which is of rare occurrence, the protrusion may pass under the lower edge of the transversalis muscle, and then receives a partial investment of cremasteric fascia, especially on its iliac side, as it comes into relation with the internal oblique. This form of direct inguinal hernia, therefore, receives very nearly the same covering that the oblique does, though its investment by the cremaster is not so perfect. It does not come into relation with the conjoined tendons.

**Relations.**—In the direct inguinal hernia, the *spermatic cord* lies to the outer side of the sac; and its elements are never separated from one another, as occasionally happens in the oblique. The *epigastric artery* also is on the outer side, but usually arches very distinctly over the neck of the sac, sometimes indeed completely encircling the upper as well as the outer margin (Fig. 682).

INCOMPLETE OR INTERSTITIAL HERNIA is usually of the oblique kind; but Lawrence has observed that it may be of the direct variety. It often escapes notice, but may not unfrequently be observed on the opposite side to an ordinary inguinal hernia.

**Double Inguinal Herniæ**, on opposite sides, are of very common occurrence, and they may be of the same, or assume different forms. In some instances, the two forms may be observed on the same side (Fig. 683).

In females, inguinal herniæ are much less frequent than in males. They may occur at all ages, but seldom come under the notice of the Surgeon except at advanced periods of life. They have the same relations as in the male, except that the round ligament is substituted for the spermatic cord.

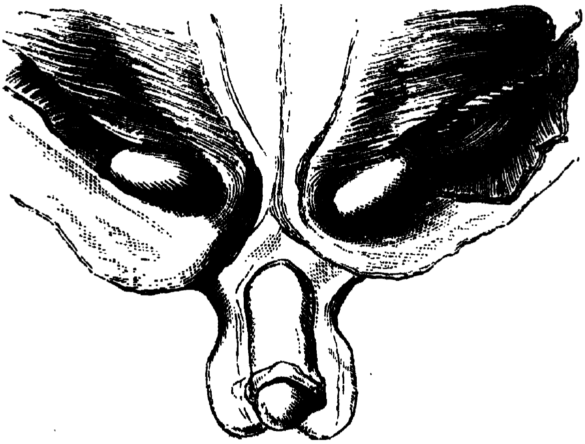


Fig. 682.—Double Direct Inguinal Hernia: Neck of Sac crossed by Epigastric Artery.

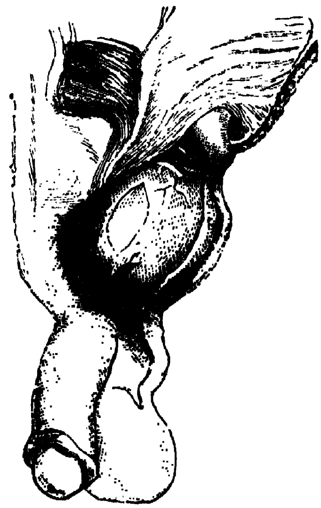


Fig. 683.—Double Inguinal Hernia on the same side: Oblique above, Direct below; separated by Epigastric Vessels.

**Signs.**—The signs of inguinal hernia vary somewhat according to its character, whether interstitial, complete, or scrotal, oblique or direct. In the *interstitial hernia*, a degree of fulness will be perceived in the canal when the patient stands or coughs ; and, on pressing the finger on the internal ring, or passing it up into the external ring, and directing the patient to cough, a distinct impulse, together with tumour, may be felt. In the ordinary *oblique inguinal hernia*, a tumour of an oblong or oval shape, oblique in its direction, taking the course of the canal downwards and forwards, will be felt protruding through the external abdominal ring, and presenting all the usual signs of a hernia. So long as it is confined to the neighbourhood of the pubes, it is of moderate size ; but when once it enters the scrotum, where it meets with less resistance, it may gradually enlarge until it attains an enormous bulk. The testicle, however, may always be felt tolerably distinct at its posterior inferior part. In women this form of hernia descends into the labium; but never attains the same magnitude as in men. When of large size, these ruptures usually contain both intestine and omentum, most frequently a portion of the ileum, though the various other viscera, such as the cæcum, bladder, &c., have been found in them. In the *direct inguinal hernia*, the symptoms closely resemble those of the oblique, except that the tumour is more rounded, and usually not so large ; the neck is wider, and situated near the root of the penis, with the cord on its outer side.

Röser directs attention to the important fact that the oblique or external inguinal hernia is most common in young males, whilst the internal or direct inguinal hernia is almost confined to elderly men. This appears to be owing to the imperfect closure of the fascicular process of the peritoneum being the common cause of the first, and adipose absorption of the second form.

The different forms of inguinal hernia are not unfrequently complicated with various other affections ; either with different kinds of rupture, or with diseases of the cord or testis, such as hydrocele of the cord or of the tunica vaginalis, or varicocele. These various complications necessarily make the diagnosis somewhat more obscure, but with care and practice it may generally easily be made out.

**Diagnosis.**—The diagnosis of inguinal hernia is usually readily effected, the characters and position of the tumour enabling the Surgeon to determine its true nature. In most cases it is useless to endeavour to ascertain whether the hernia is oblique or direct ; all old oblique herniæ having a tendency to drag the inner ring downwards and inwards, approximating it and bringing it nearly opposite to the outer one, shortening and destroying the obliquity of the canal. Hence the direction of the neck and of the axis of the tumour in these cases so nearly resembles what is met with in the direct form of hernia, that the Surgeon should not attempt to undertake an operation, more particularly the division of the stricture, on any imaginary diagnosis. Some forms of *femoral hernia* may occasionally be confounded with the inguinal ; the distinguishing points between these two forms of the disease will be considered in the section on femoral hernia.

The diagnosis of inguinal hernia from other diseases in this vicinity has to be considered under the two conditions in which the rupture is found,—1, *in the canal*, and 2, *in the scrotum*.

1. Whilst still lying *in the canal,* inguinal hernia requires to be diagnosed from the following conditions. *a. Abscess,* descending from the interior of the abdomen or pelvis through the canal, and passing out through the abdominal ring. The diagnosis may here be effected by recognising the soft fluctuating feel of the abscess, which, though reducible on pressure, and descending on coughing with a distinct impulse, does not present the more solid characters and the gurgling sensation of a hernia. *b. Encysted* or *Diffused Hydrocele of the Cord.* In the *encysted hydrocele* there is a smooth oval swelling situated on the cord, which can be apparently reduced, being pushed up into the canal, and descends again on coughing or straining; but it may be distinguished from hernia by being always of the same size, by not being reducible into the cavity of the abdomen, by the absence of all gurgle, and by its very defined outline. In the *diffused hydrocele* of the cord, the absence of distinct impulse on coughing, the impossibility of returning the swelling completely within the abdominal cavity, and of feeling the cord in a free and natural state, will prevent the disease from being confounded with hernia. *c. Hæmatocele of the Cord.* Here the soft and fluctuating nature of the swelling, the ecchymosis, the impossibility of complete reduction, and the absence of gurgling, will indicate its true nature. *d. Fatty or other Tumours* occasionally form on the cord; but the circumscribed character and limited size of these swellings, the absence of impulse on coughing, and of reducibility into the cavity of the abdomen, will point out that they are not herniæ. *e. Lodgment of the Testis in the Inguinal Canal* will give rise to a tumour, which closely resembles incomplete inguinal hernia: and if it should happen to become inflamed in this situation, the difficulty of the diagnosis from strangulated hernia may be very considerable. In the ordinary undescended testis, the absence of that organ in the scrotum on the affected side, the peculiar sickening pain occasioned by the pressure of the tumour, the absence of gurgling, and of all possibility of reduction, will enable the diagnosis to be effected. *f. Inflamed Undescended Testis.* From this it is not always at once easy to effect the diagnosis of incomplete inguinal hernia in a state of strangulation, with which indeed it may be complicated. This diagnostic point will be more fully treated of in speaking of congenital hernia. In the meanwhile, it may be stated that the absence of *persistent* and *continuous* vomiting and constipation, the feel of the tumour, hard below, elastic above, and the peculiar pain when it is compressed, will enable the Surgeon to recognise the true nature of the tumour as being a retained and inflamed testis.

2. When the hernia has descended *into the scrotum,* it may be confounded with: *a. Hydrocele of the Tunica Vaginalis.* In this disease there is an oval or pyriform tumour, usually translucent, unchangeable in size or shape by pressure, and having the cord clear and distinct above it, with an absence of impulse on coughing, or of gurgling in attempts at reduction. In cases of congenital hydrocele in children, in which there is still an opening communicating with the peritoneal cavity, the tumour may be diminished in size by steady pressure, but gradually returns, fluctuates, and is translucent. In these cases its translucency, and the gradual manner in which the sac is emptied and is refilled, very different from the sudden slip up and protrusion of a hernia, enable the Surgeon to establish the diagnosis. It not unfrequently happens that *hernia is complicated with hydrocele of the tunica vaginalis.* In these cases the

two separate tumours can usually be distinguished, there being some degree of constriction, or of consolidation, between them. The hydrocele will present its ordinary characters of translucency, irreducibility, and circumscribed outline, and is commonly placed anterior to the hernia, which lies towards the back of the scrotum, and may be distinguished by its reducibility and impulse on coughing. It sometimes happens, as in a case which once fell under my observation, that a *hydrocele of the cord is associated with one of the tunica vaginalis and a hernia;* in such circumstances, the diagnosis requires a little care, but may be effected readily enough by separately determining the characters of the different swellings. *b. Varicocele.* Here the diagnosis may be effected in the way pointed out by Sir A. Cooper. The patient should be placed in the recumbent position, and the swelling reduced; the Surgeon then presses upon the external ring with his fingers, taking care to cover the whole of it, and desires the patient to stand up. If it be a hernia, the tumour cannot descend; but if it be a varicocele, it will speedily reappear *whilst the pressure is being kept up*, the blood being conveyed into it through the spermatic arteries. *c. Tumours of the Testis.* These may be distinguished from hernia by their solid feel, rounded shape, by the absence of all impulse on coughing, and, especially, by the cord being felt free and clear above them, and the inguinal canal unoccupied. *d. Hæmatocele of the Tunica Vaginalis.* Here the cause of the swelling, its pyriform shape, opacity, solid feel, the absence of impulse on coughing, and the defined characters of the cord, will enable the Surgeon to make the diagnosis.

**Treatment.**—When inguinal hernia is reducible, the rupture must be kept up by a well made truss, the pad of which, of an oval shape, should press not only upon the external ring, but upon the whole length of the canal. It is in this form of hernia that the various operations for the radical cure are most applicable. When it is irreducible, and of large size, nothing can be done beyond supporting it in a bag-truss.

**Operation.**—When the hernia is strangulated, if the taxis properly employed in the direction of the canal have failed, the operation must be performed in the following way. The bladder having been emptied and the pubes shaved, the patient should be brought to the edge of the bed; and the Surgeon, standing between his legs, and having the skin covering the external ring well pinched up, divides the fold in the usual way, by an incision three inches in length, commencing about an inch above the external abdominal ring. Should any spouting vessels, as the external pudic, be divided in this incision, they had better be ligatured. The Surgeon then proceeds with the section through the subcutaneous structures; he will, in many cases, find the superficial fascia considerably thickened, particularly if the patient have long worn a truss. He divides this structure in the line of the external incision, and then exposes the intercolumnar fascia, which will also generally be found thickened, and incorporated with the superficial fascia. In many cases, the intercolumnar fibres will be found condensed into a thick and broad fillet, which limits the further extension of the ring, and produces an evident constriction upon the neck of a large inguinal hernia. An opening should be carefully made into this fascia, a grooved director passed under the edge of the ring, and this slit up. In some cases, though but very rarely, it will now be found that the hernia may be reduced, its strangulation depending on the constriction of the margins of this aperture; most commonly, however, the stricture is situated deeper than this. The cremasteric fascia, which is generally considerably thickened, is now exposed, when its fibres will be found to form a kind of reticulated mesh over the hernial tumour. This structure must be carefully divided upon a director, when the transversalis fascia and subserous areolar tissue, or *fascia propria*, will be laid bare. This structure is usually thickened and vascular, and not unfrequently the stricture appears to be situated in it, or in a kind of condensed ring formed by the incorporation of it with the meshes of the cremaster. If it be found, after the division of these fasciæ, that the hernia can be reduced, it would of course be unnecessary to lay open the sac; and the safety of the patient will be considerably enhanced, more particularly if the operation be performed for an old scrotal hernia of large size, by not doing so. If, however, as will happen in the majority of instances in inguinal hernia, it be found that the stricture is in the neck of the sac itself, occasioned by a condensation, constriction, and puckering of it, the sac must be carefully opened at its anterior part, the finger introduced, and the stricture divided from within, by pressing the finger-nail under it, and cautiously sliding the hernia-knife along this. It is an established rule in surgery, that this division should be effected in a direction immediately upwards, so that it may lie parallel with the epigastric vessels, whether it be situated upon the inner or outer side of these. It is true that, if the Surgeon could be sure that he had to do with an oblique inguinal hernia, he might safely divide the stricture outwards; or, if he were certain that the protrusion was of the direct kind, he might make the section inwards; but, as it commonly happens that he cannot determine with absolute certainty upon which hernia he is operating, he adopts the safer plan recommended by Sir A. Cooper and Lawrence, of cutting upwards from the middle of the ring parallel to the epigastric vessels.

The **Seat of Stricture** in inguinal hernia will thus be seen to differ in different cases; and in some instances it exists in two situations. I think it most commonly occurs in the neck of the sac, owing to contraction and elongation of it, with condensation of the subserous areolar tissue lying immediately upon it. In other cases, though much more rarely, it seems to be formed by a thickening of the transversalis fascia in the inner ring, but altogether outside the sac. Occasionally it is met with in some part of the canal, at the lower edge of the internal oblique, but much more frequently at the external abdominal ring. In many cases there is very tight constriction in this situation, as well as in the deeper portions of the canal, or at the inner ring; hence, after the division of any stricture at the external abdominal ring, the deeper portions of the canal should always be carefully examined before any attempt is made to put the hernia back.

The operation for an *Incomplete Inguinal Hernia* requires to be conducted in the same way as that which has just been described, except that the incision need not be quite so long, and should not extend beyond the external ring. After this has been laid open, and the tendon of the external oblique slit up, a flat director must be passed under the lower edge of the internal oblique and transversalis muscles, which must be carefully divided; should the stricture not be relieved in this way, and the sac require to be laid open, the deep section must be made in the same way and in the same direction as has already been described.

In **Inguinal Herniæ, containing either the Cæcum, the Sigmoid Flexure of the Colon, or the Urinary Bladder,** the protruded viscera are only partially covered by peritoneum; hence, in operating upon such herniæ, when strangulated, care must be taken that the contents be not wounded, which is apt to occur if the Surgeon divide the parts without due caution, not suspecting himself to have reached the neighbourhood of the viscus, but believing that he has met with a sac which does not exist. As the protruded parts are generally adherent in these cases, the Surgeon must content himself with leaving them unreduced after the division of the stricture; in such circumstances, it has happened that the protrusion is ultimately drawn back into the abdomen by some natural action of the parts.

Operations for strangulated inguinal hernia are required during a greater range of ages than those for any other kind of protrusion. I have operated successfully for congenital hernia in infants less than six weeks old, and for ordinary oblique inguinal hernia at seven weeks and at four months of age; and the operation has been done on centenarians. When small and recent, the protrusion usually consists of intestine only; when large, it commonly contains omentum as well. The treatment of these contents, and the after-management of the case, must be conducted in accordance with the rules laid down at pages 640 *et seq.* vol. II.

HERNIA IN THE TUNICA VAGINALIS: CONGENITAL HERNIA.—In this case the hernia descends inside the tunica vaginalis, which constitutes its sac. It is always oblique, and takes the course of the spermatic cord; most commonly descending into the scrotum, but sometimes lying within the canal, out of which perhaps the testis has imperfectly passed. This hernia differs from an ordinary oblique hernia in the absence of a true peritoneal sac, and in the protruded parts lying in the tunica vaginalis and in contact with the testicle (Fig. 684). The great peculiarity, indeed, of this hernia, consists in its descending along the canal left open by the descent of the testis. In the fœtus the testis originally lies below the kidney, and, as it descends in the later months of intra-uterine life into the inguinal canal and scrotum, it pulls down a prolongation of the peritoneum, exactly resembling a hernial sac. In addition to this defective closure of the vaginal process of the peritoneum, there is another anatomical condition which tends to the formation of a congenital inguinal hernia—viz., an abnormally long mesentery. This, unlike the open peritoneal process, is not necessary to the formation of the hernia, but when existing it is a material factor in its production. And it is attended by this serious inconvenience, that it is an obstacle to the radical cure of the hernia by the closure of the open funicular process of peritoneum by the pressure of a truss.

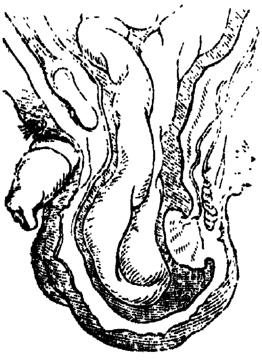


Fig. 684.—Congenital Hernia.

That prolongation of the peritoneum which is carried down around the testis in its descent, may be divided into two portions, the funicular and the testicular. The *funicular* is that which corresponds to the cord, extending from the internal ring to the scrotum; the *testicular* is that which becomes the tunica vaginalis. A congenital hernia occurs in consequence of the funicular prolongation not becoming, as in the normal condition, converted into a filamentous fibro-cellular tissue, but remaining pervious, and thus serving as a medium of communication between the general cavity of the peritoneum and the tunica vaginalis; and along the open channel thus left the congenital hernia descends. The reason why in many cases the hernia is not truly congenital, but occurs in after-life, is that the funicular portion is only partially closed or contracted, and that, under a sudden effort, the septum is broken through, and thus a knuckle of gut falls into the tunica vaginalis.

Hernia of the tunica vaginalis, though usually called "congenital," is rarely so in reality; the tendency is congenital, but the disease is not. It not unfrequently happens, it is true, that these herniæ show themselves early in life, in infants a few weeks or months old; though at these ages even the funicular prolongation of the peritoneum may be so completely occluded, that the hernia which occurs is of an ordinary oblique character. Not unfrequently, however, the hernia does not take place until a considerably later period of life than this, and may suddenly happen in the adult; thus Velpeau relates instances in which it occurred for the first time between the ages of eighteen and twenty-five. I have operated in a case on a man thirty-five years of age, in whom this kind of hernia occurred for the first time when he was twelve years old; and some years ago in a case at the Hospital, on a man about fifty, in whom, on the most careful inquiry, it would appear that the protrusion had not shown itself until he was about thirty years of age.

*Signs and Diagnosis.*—The signs of hernia in the tunica vaginalis closely resemble those of the ordinary oblique; most commonly, however, if scrotal, the tumour is much rounded, and the neck feels narrow and constricted. The testis, also, cannot be felt distinct and separate from the tumour, but is surrounded by, and, as it were, buried in the substance of the hernia, through which it may sometimes be felt at the lower and back part of the scrotum. On inquiry, also, it will usually be found either that the hernia has existed in childhood, or the testis is still in the canal, or has descended later than usual. A hernia of the tunica vaginalis may be associated with a congenital hydrocele. In these cases, after the fluid has been returned into the peritoneal cavity by directing the patient to lie on his back, and raising the scrotum, the portion of protruded gut may be felt and recognised by its gurgle and upward slip when reduced. This hernia may be associated with the testis in two conditions—viz., either undescended, lying in the canal or at the anterior abdominal ring, or higher up in the canal. In the first case, the hernia is, of course, incomplete; in the second, it is scrotal. When incomplete, the diagnosis may be made by feeling a soft swelling with the ordinary hernial signs above the small and hardened testis.

When symptoms of strangulated hernia occur in a person in whom the *testes have not descended* into the scrotum, very great difficulty may be experienced in effecting an exact diagnosis. In such cases as these, an oblong or rounded tumour, tense and painful, will be found to occupy the inguinal canal, not passing beyond the external ring, with some abdominal tenderness, and possibly nausea and constipation. The question here arises as to the nature of this tumour. Is it simply an inflamed undescended testis; or is it an undescended testis, inflamed or not, as the case may be, having a knuckle or loop of strangulated intestine lying behind it?

When the tumour simply consists of an inflamed undescended testis, the pain will be of that peculiar character which is indicative of orchitis, and the constitutional symptoms of strangulation, however simulated for a time, will not be persistently present. The following case is a good illustration of this condition. A man, aged about forty, said to be labouring under strangulated hernia, was sent up from the country for operation. On being called to him, I found the house-surgeon attempting the reduction of the tumour in the hot bath; but as soon as I felt the swelling, I was convinced, from its hard, solid, and irregular feel, that it was not a hernia. On inquiring into the history of the case, it appeared that the patient had for the last two days suffered from occasional vomiting, and had been constipated; that the tumour in the groin had not appeared suddenly, though it had enlarged with great rapidity; that it was excessively painful; and that he had always worn a truss for a supposed rupture on that side, until the last few weeks, when, in consequence of the instrument breaking, he had discontinued it. On examining the groin carefully, a tumour about as large as the fist was found in the right inguinal canal; it was tender to the touch, hard, and irregular at the upper and outer part, but somewhat soft and fluctuating below; when the finger was passed into the external ring, the outline of the tumour could be very distinctly felt in the canal. There was no impulse in it on coughing, but some abdominal tenderness on that side. The right testis was not in the scrotum. I ordered the man to be bled, the tumour to be leeched, and salines administered: under this treatment the case did well. When a knuckle of strangulated intestine lies behind and above the testis, still retained above the external ring, the symptoms of strangulation will be violent and persistent; and this, even though the tumour present but little the feel or the ordinary character of a hernia. In fact, in such a case, the Surgeon is guided by the character of the general symptoms, and not by those of the local tumour. In a case of this kind to which I was called, there could be felt behind and above an inflamed and swollen testicle, which lay at the external abdominal ring, a small, hard, round tumour in the upper portion of the canal. As symptoms of strangulation were urgent, this was cut down upon, the anterior wall of the canal was incised, and the tunica vaginalis, much distended with fluid, was laid open, when a small knuckle of intestine was found lying at its upper part, very tightly constricted by the inner ring. But in other cases the diagnosis is not so easy; the whole tumour lying in the canal feels smooth, elastic, and uniform, so that no manual examination can enable the Surgeon to say with certainty whether the tumour is an inflamed testis surrounded by fluid in a distended tunica vaginalis, or whether there is a loop of intestine lying above an undescended testis. In such cases as these, however, the Surgeon is guided in the course he should adopt by the symptoms. If these indicate strangulation of intestine, and persist after a reasonable time has been consumed in the application of leeches and the administration of purgatives, he should, without further delay, cut down on the tumour and examine its composition. If it be herniary in part, the internal ring will require division, the intestine must be reduced, and the testis put back in the canal.

*Treatment.*—The treatment of congenital hernia consists in the reduction of the tumour, and the application of a proper truss, the pad of which should compress the whole length of the inguinal canal. In children, a radical cure may be effected in this way; but, in order to accomplish this desirable result, the truss must be worn for several years. The application of a truss with an air-pad will in many instances be found especially useful, as it applies itself with greater exactness than an ordinary incompressible one. In applying the truss, care must be taken not to compress the testis if undescended. In order to avoid this, the lower end of the pad may be cut out so as to be concave, and thus press down the testis while it supports the hernia.

When strangulated, congenital hernia does not commonly admit of reduction, and thus necessarily renders an operation imperative. The procedure is more commonly required for this kind of hernia in adults than in infants. The operation is the same as that for oblique inguinal hernia, but the parts concerned are usually thinner, the tunica vaginalis serving for a sac; hence more caution than usual is required in these cases. The sac commonly contains a large quantity of fluid, usually clear, but often dark in colour, there being, in fact, a hydrocele conjoined with the hernia. The stricture will always be found in the neck of the sac, which appears to be condensed, elongated, and narrowed; hence it is useless in these cases to endeavour to relieve the strangulation, without laying open the sac, and dividing its neck from within. As the congenital hernia is always external to the epigastric vessels, the section of the stricture may be done with perfect safety in a direction upwards and outwards, though, if the Surgeon should have any doubt as to the exact nature of the case, it will be better to divide the stricture directly upwards. The stricture, in fact, appears to be formed by the imperfect contraction of that portion of the funicular prolongation of the peritoneum, which normally becomes obliterated before birth, and establishes the separation between the two serous sacs of the tunica vaginalis and of the peritoneum. The reduction of the contents of the hernia will in the adult often be prevented by adhesions in the neck of the sac, or between them and the testis. I have found both the gut and omentum closely incorporated with this organ, and requiring some nice dissection to separate them. In operating upon infants of a very tender age, much caution will necessarily be demanded, on account of the tenuity of the coverings, their tension, and the small size of the apertures. The testis, as well as the spermatic cord, the veins of which are excessively turgid, come into view, and will usually be found much congested, and of a black or bluish-lack colour.

A species of congenital hernia has been met with in the *female*, especially in children, in which the protrusion takes place into the canal of Nuck, which invests the round ligament. In one instance, I have seen a double inguinal hernia in a girl of five years old. It is of extremely rare occurrence, and requires the same treatment as the corresponding disease in the male.

**Encysted Hernia of the Tunica Vaginalis, or Infantile Hernia,** as it has been somewhat absurdly termed, occurs in those cases in which the funicular portion of the tunica vaginalis is partly obstructed by a septum, or by being converted into filamentous tissue, but in such a way as to leave a pouch above, which is protruded down behind or into the tunica vaginalis, so that it lies behind this cavity (Fig. 685). There are no characters by which the encysted can be distinguished from the ordinary congenital hernia. If it should become strangulated, it must be borne in mind that during the operation the tunica vaginalis will first be opened ; no hernia will be seen here, but the tumour lies behind this sac, and requires to be dissected into through the double serous layer of which it is composed. The stricture will probably be in the neck, and requires to be divided in the usual way.

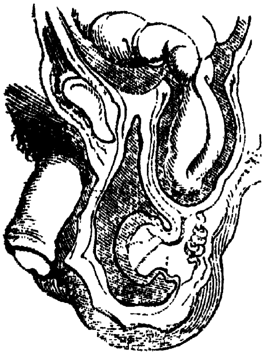


Fig. 685.—Infantile Hernia.

### FEMORAL HERNIA.

By **Femoral Hernia** is meant a protrusion that escapes under Poupart's ligament, and enters the sheath of the vessels internally to the femoral vein. This hernia passes down to the innermost compartment of the sheath, which is occupied by fat and lymphatics, and usually contains a gland or two. It passes first of all through the crural ring, where it has Gimbernat's ligament to its inner side ; the septum which separates the femoral vein from the inner compartment of the sheath of the vessels, to its outer aspect ; Poupart's ligament in front ; and the bone behind (Fig. 686). After passing through the crural ring, it enters the crural canal, which extends for about an inch and a half down the thigh on the pectineus muscle, and is covered by the iliac prolongation of the fascia lata. As it approaches the lower corner of the saphenous opening where the canal terminates, it passes under the falciform process of the fascia lata, and out upon the thigh through the saphenous aperture ; here it expands, becomes rounded, and has often a tendency to turn upwards over Poupart's ligament (Fig. 687), lying in this way upon the iliac region, and sometimes even ascending to some distance upon the anterior abdominal wall.

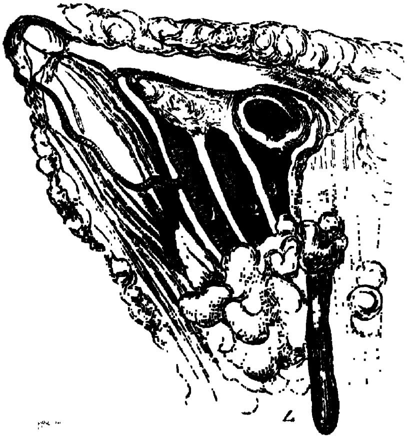


Fig. 686.—1. Femoral Artery ; 2. Femoral Vein ; 3. Innermost Compartment of the Sheath of the Vessels, into which a small Hernia is protruding ; 4. Saphena Vein.

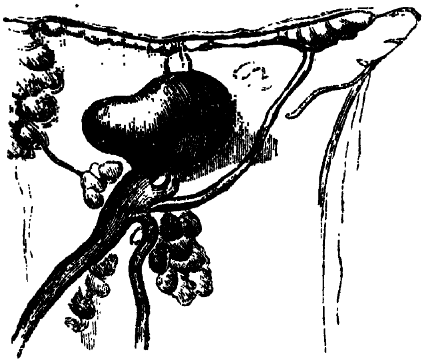


Fig. 687.—Femoral Hernia turning upwards.

In the descent of the hernia through this course, it first of all pushes before it the peritoneal sac, and then receives an investment of the subserous areolar tissue—the **septum crurale**, a mass of dense areolar tissue, containing fat and lymphatics, occupying the crural ring. This septum often becomes incorporated and matted with the contiguous portion of the sheath, thus constituting the **fascia propria** of this hernia, which is commonly thickened, laminated, and of an opaque fatty structure, like omentum. As the hernia continues to descend, it comes into relation with the cribriform fascia, which occupies the saphenous opening, and, lastly, pushes before it the integumental structures.

As the tumour descends through this course, it necessarily comes into relation with very important parts (Fig. 688). Thus it is separated from the femoral vein solely by the septum of the sheath of the vessels. It has the epigastric artery above and to its outer side ; and the spermatic cord in the male, or the round ligament in the female, almost immediately above it. The obturator artery, when arising in the normal manner from the internal iliac, does not come into relation with the neck of the sac ; but when it takes its origin, as it not unfrequently does, from the external iliac, the common femoral, or the epigastric, it may have important relations to this part of the hernia. Most commonly, in these circumstances, it passes to the iliac or outer side of the neck, but occasionally it winds round its inner or pubic side, coming into rather close relation with it ; and then, as will immediately be mentioned, it may be in considerable danger during the operation. The combination, however, of this particular variety of the obturator artery and femoral hernia, is a very uncommon occurrence ; because, in the first place, this internal distribution of the artery is rare ; and when it does occur, as it passes directly over that portion of the crural ring through which the sac would protrude, it necessarily strengthens this, and so diminishes the chance of rupture.

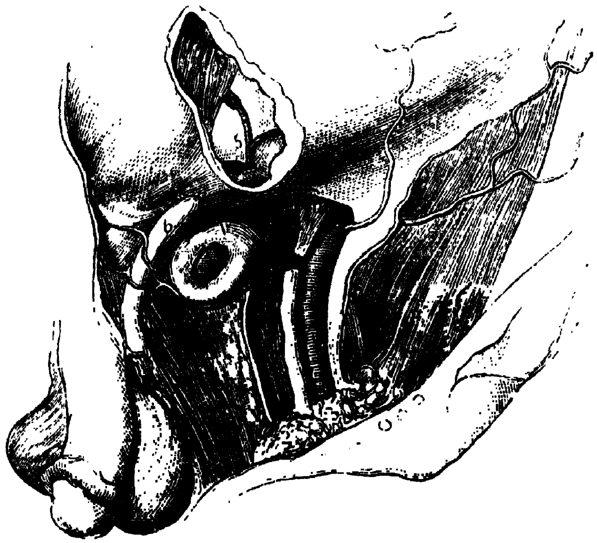


Fig. 688.—1. Femoral Hernia : 2. Femoral Vein : 3. Femoral Artery, giving off, 4, Common Trunk of Epigastric and Obturator Arteries, and 5, Epigastric Artery ; 6, Spermatic Cord.

**Contents.**—The contents of a femoral hernia are usually intestinal, and most commonly consist of a portion of the ileum. Occasionally omentum is contained within the sac, but seldom in large quantity. I have, however, several times had occasion to operate in cases of old femoral hernia, in which it became necessary to remove large portions of adherent omentum; in one, ten and a half ounces, and in the other about seven. In each case there was a small knuckle of intestine strangulated behind the omentum. The ovaries, Fallopian tubes, &c., have been known to be strangulated in this variety of hernia.

**Signs.**—The signs of femoral hernia are usually well marked. They consist of a tolerably firm, tense, and unyielding tumour, of a rounded shape, situated in the groin, to the inner side of the femoral vessels, and to the outer side of the spine of the pubes, having its neck under Poupart's ligament, though, as it increases in size, its base may be turned above the structure; sometimes, though rarely, it passes downwards upon the thigh. Its size varies considerably; most commonly it is not larger than a walnut or a pigeon's egg, and then is deeply seated in the angle between the body of the pubes and the femoral vessels; but occasionally it may attain a considerable bulk, as large as the fist or a French roll. When large, this hernia usually rises up above Poupart's ligament, and extends outwards in a direction parallel to it, so that it assumes an elongated shape; it is then usually somewhat doughy and soft, even when strangulated; very different from the excessively tense feel that it has when small.

In some rare cases the femoral hernia has been found lying external to the vessels, the mouth of the sac being between them and the iliac spine. In these circumstances strangulation cannot well occur, inasmuch as the mouth will be the widest part of the sac; but, as Hesselbach has observed, if the fascia iliaca be torn by the pressure of the tumour, the rupture may be strangled in the aperture thus formed. Should an operation ever be required in such circumstances, it must be borne in mind that the circumflex ilii artery may be in some danger.

As a femoral hernia passes out through the crural ring, it comes into very close relation to the femoral vein, being merely separated from the vessel by the septum, which divides the inner from the middle compartment of the femoral sheath. Were it not for this septum, as Röser has observed, the femoral vein would be compressed by the tense hernial tumour protruded between it and Gimbernat's ligament, and the inevitable consequence would be œdema of the whole lower extremity. As the hernia pushes down in the track of the crural canal, it can make no impression on the inner or on the posterior wall of the canal—both of which are unyielding; but, pushing the anterior wall upwards, it drags upon the septum on the outer side of the neck of the sac, renders this tense, and thus saves the femoral vein from compression.

**Diagnosis.**—The diagnosis of femoral hernia is not always easy. When the hernia is large, and more particularly when it rises up above Poupart's ligament, which some herniæ, even of very moderate size, are apt to do, it might at first be mistaken for an inguinal rupture. The diagnosis, however, may usually be effected by ascertaining the relation that the neck of the sac has to

Poupart's ligament, the inguinal hernia being situated *above*, the femoral *below* this cord. When, however, a small femoral hernia in a fat man rises upwards, so as to lie over Poupart's ligament, it resembles very closely an incomplete inguinal hernia; but its characters may be determined by the passage of the finger up the inguinal canal, which will be found to be free, and the hernia can only be felt through its posterior and inferior wall. In the female the finger cannot be passed up the canal, but the inguinal hernia will descend into the labium, and may thus be recognised from the femoral, which lies in the upper and inner part of the thigh. In both sexes the relations of the neck of the sac to the spinous process of the pubes, which can always be felt in the fattest subjects, are most important in a diagnostic point of view. In femoral hernia the spine is to the inner, in inguinal hernia to the outer side of the protrusion; and, should a patient happen to be the subject of both inguinal and femoral herniæ on the same side, the spine would be felt between the two. After reducing a femoral hernia, the finger also can usually be pushed into the inferior aperture of the crural canal, when the situation and sharp outline of the falciform process will determine the nature of the opening through which the protrusion has occurred.

The diseases occurring in the groin, with which femoral hernia may most readily be confounded, are—1. *Enlarged Lymphatic Glands* in this situation. From these it may be distinguished by the absence of impulse in the glandular tumour, and by the simultaneous enlargement of several glands. A small strangulated hernia may, however, co-exist with these; being subjacent to, and covered in by them. When this is the case, and the local signs of hernia are obscure, whilst the symptoms of strangulation continue, an incision should be made into the part, and the dissection carefully carried through and underneath the glands, with the view of determining whether the hernia exist or not. 2. *A small Fatty Growth* has been met with in the crural canal, closely simulating a hernia. The want of impulse on coughing, together with its limited and doughy character, and the absence of circumscription in the tumour, will enable the Surgeon to distinguish it from hernia. 3. *Psoas Abscess* not unfrequently points very nearly in the situation of femoral hernia: from this it may, however, be distinguished by its fluctuating feel, by its soft yet semi-elastic character, and by the general history of the case. The impulse on coughing, which is very distinct in the abscess, is commonly more forcible and direct than that of a hernia; and although the purulent collection may in many cases be squeezed back into the abdomen when the patient lies down, yet it returns without a gurgle, and without that distinct slip which accompanies the reduction of a hernia. 4. *Varix of the Saphena Vein* is in some danger of being confounded with hernia. It may, however, be distinguished from this by the impulse in it being less distinct than in hernia, and by the enlargement of the lower part of the vein being marked in the varix, but not existing in the rupture.

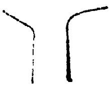
Femoral hernia most commonly occurs in women, and very seldom under the age of twenty; differing in both these respects from the inguinal rupture. Sir A. Cooper states that he had only seen three cases under the above age. It very seldom becomes strangulated at an early period of life, even when existing. I have had a girl of nineteen under my care with femoral hernia, in whom strangulation had already occurred on four occasions; reduction, however, having been happily effected each time.

**Treatment.**—The treatment of femoral hernia, when it is reducible, must be conducted in the ordinary way by the application of a proper truss. A cure, however, is never, I believe, effected by the pressure of a pad, as sometimes happens in inguinal hernia; owing probably to the rigidity and incompressibility of the tendinous and aponeurotic structures through which this rupture protrudes. It is often difficult to keep this form of hernia up by means of a truss. The best instrument for this purpose is the mocmain truss, which I have found to succeed when all others have failed. When the hernia is irreducible, it should be supported by means of a truss with a concave pad.

When a femoral rupture is strangulated, reduction should be effected either by taxis or by operation as speedily as possible, gangrene more rapidly ensuing in this than in any other form of hernia. In attempting the taxis, the structures in the groin should be well relaxed by flexing the thigh upon the abdomen, and adducting it, which relaxes the margin of the saphenous opening; if it do not succeed with the assistance of the means recommended at p. 631, Vol. II., the operation should be proceeded with at once. The operation for strangulated femoral hernia may be undertaken earlier and with a better prospect of success than that for any other form of rupture; this is owing to the stricture being so commonly seated outside the sac, that the operation usually admits of being completed without implicating the peritoneum. The advantage of this mode of procedure in femoral hernia has been fully pointed out by A. Key, Luke, and Gay, and is now very generally recognised in practice. Gay, more particularly, has pointed out that the stricture may commonly be divided without opening the sac, by making a very limited incision on the inner surface of the neck of the tumour; and he observes that the operation undertaken in this manner is little more than the taxis with the addition of a superficial incision. There is, however, this important difference between a hernia reduced by the ordinary simple taxis and one returned by Petit's operation, that the strangulation in the latter case has been far tighter, or the operation would not have been necessary, and the consequent injury to the protruded parts is much more severe.

The stricture in femoral hernia is often found to be occasioned by the pressure of the crural arch. Lawrence states that it may be most effectually relieved by dividing the thin posterior border of this arch near the pubes. Other Surgeons recommend that the sharp edge of Gimbernat's ligament should be divided; and others again that the division should be made at the junction of Gimbernat's and Poupart's ligaments—through those ligamentous bands which were first described by Hey, under the term of the "femoral ligament" (1803), though subsequently (1814) he dropped this designation (they are now sometimes called "Hey's ligament")—or at the inner edge of the falciform process; and, indeed, it is in this situation that both Lawrence and Hey direct the incision to be made. In operating for femoral hernia, I have certainly most frequently found the stricture still to continue after the division of these ligamentous structures, and to be occasioned by fibrous bands, often very distinct, narrow, and glistening, lying across the neck of the sac in the fascia propria of the hernia; and I agree with the opinion expressed by Sir A. Cooper, that the neck of the sheath is the common seat of strangulation in femoral hernia; these transverse fibres, which sometimes appear to be partially reticulated, consisting probably of a condensation of the tendinous fibres that are normally found in the sheath of the vessels. In order to expose them, it is commonly necessary to draw the neck of the sac well down, when they will be seen deeply to indent and constrict it.

**The operation without opening the sac** may most conveniently be performed when the tumour is small, by making an incision by transfixion along the inner side of its neck, and then dissecting through the superficial structures until the fascia propria is brought into view and carefully opened, and the sac exposed. The point of the finger should then be carried to the lower side of this, well under the fascia propria. The finger-nail or flat director may then be insinuated under the sharp edge of Gimbernat's ligament; which, at the point of junction with Poupart's, may be divided upwards and inwards to the extent of a line or two by means of a hernia-knife. By this incision, not only is the edge of Gimbernat's and Poupart's ligaments divided, but also the condensed and compressed fascia propria lying between the sac and the inner side of the crural arch. The reduction may now be attempted, and often effected: should any obstacle exist, the neck of the sac must be well drawn down and exposed, and any transverse bands situated upon it dissected through with the scalpel and forceps, or divided on a director. These bands lie in the fascia propria; and when they are found, it is usually owing to the Surgeon not having exposed the neck of the sac sufficiently before passing his nail or director under the stricture. It is owing to the incision being confined to the constriction occasioned by the crural arch only, not including, as it ought to do, the subjacent condensed fascia propria; a point of very great practical importance. Sometimes this condensed and constricting portion of the fascia propria is so closely incorporated with the neck of the sac, that it cannot be divided without opening the latter. The operation performed in this way, without opening the sac, is certainly a very simple procedure; and adds little if anything—nothing more, in fact, than a simple incision through superficial structures—to the danger of the patient.

If it be thought desirable to **open the sac**, or if it be necessary to do so in consequence of its incorporation with the fascia propria, the operation must be performed in a different manner, the parts requiring to be rather fully exposed; and indeed, if the tumour be of any considerable magnitude, even though the sac be not opened, it will be better to expose the part somewhat more freely in the way to be described. An incision should be made parallel to Poupart's ligament, by pinching up the skin, and then a transverse cut from the centre of this carried over the tumour so as to present the following shape  : the dissection must then be carried through the superficial fascia, when the septum crurale or fascia propria will be exposed; in some cases, especially if the hernia be a large one, this is thin, and requires to be carefully slit up on a director. In many instances, however, it is so dense, laminated, and changed in structure, as scarcely to be recognised for what it is.

It not unfrequently happens that, after the superficial fascia has been divided, an oval, smooth, and firm body is exposed, which at first looks like the hernial sac, or a lump of omentum; this is in reality the fascia propria, thickened by the long-continued pressure of the truss, and congested perhaps by the attempts at reduction; and in the midst of it, the sac will at last be found, after the dissection has been carried through several layers of this tissue. In it cysts containing bloody serum may occasionally be found, and then the difficulty in the recognition of the structures is greatly increased. Though the mobility of this mass, the facility of tracing its neck, and the roundness of its general outline, often cause it to be mistaken for sac or omentum, it may be distinguished from the first by the absence of the characteristic vessels upon its surface, and from the second by its more rounded, solid feel, and uniform appearance. When the sac has been reached, it must be very carefully opened, there being usually very little if any fluid between it and its contents; the finger-nail must then be passed under the sharp edge of the stricture, which should be divided in a direction upwards and inwards. The reason why this line of incision is universally chosen by Surgeons in this country at the present day, is, that it is the only direction in which the stricture can be divided without risk of inflicting serious injury upon neighbouring parts. If the section be made outwards, the femoral vein will be in danger; if upwards and outwards, the epigastric artery; if directly upwards, the spermatic cord: hence the only direction is either inwards, or upwards and inwards. If the cut be made inwards, the sharp edge of Gimbernat's ligament alone will be divided, and the crural arch not sufficiently liberated. But if the division be made upwards and inwards, the ilio-femoral ligament will be divided, and thus the tension of the whole of the arch lessened; the only danger that can occur from the division of the stricture in this direction is the very remote one of the division of the obturator artery, when it takes the anomalous course round the inside of the neck of the sac. Guthrie states that he has known some of the best Surgeons in London to lose patients by hæmorrhage after the operation for femoral hernia. This accident, however, must be of extremely rare occurrence, and might in a great measure be guarded against by slightly blunting the edge of the hernia-knife before dividing the stricture, so that the tense fibrous bands constituting the constriction would yield, while the artery would probably escape, being pushed before the blunted edge. I have, however, more than once seen blood well up rather freely on the division of the stricture; but it has ceased spontaneously, and I have never known it to give any trouble. If the division of the stricture be limited to a line or two, there will be but little danger of wounding the vessel, even when it takes the abnormal course.

A case in which this accident happened is recorded by A. H. Corley, of the Jervis Street Hospital, in Dublin. The bleeding was very free, but was easily controlled by passing the fore finger into the wound and grasping the abdominal wall between it and the thumb. A curved needle was accordingly passed in through the ring and out immediately above Poupart's ligament, and a twisted suture applied round it. The hæmorrhage ceased, and did not recur. The patient died from other causes, and the *post mortem* examination showed the obturator arising from the epigastric and cut opposite the neck of the sac. The two ends had retracted one inch apart, the distal having gone so far in the direction of the obturator foramen that any attempt to reach it would have been out of the question. The needle was found to have passed immediately in front of the proximal end, crossing the track of the artery, but not actually including it within the ligature; yet the traction so exerted seems to have been enough to close the vessel, as it was obliterated by a clot. The distal end contained no clot. From this case, it is evident that acupressure is the most hopeful means of dealing with such an accident, but it can only be applied to the proximal end. In this case no hæmorrhage occurred from the distal end, but the patient was much exhausted, and lived only thirty hours after the operation.

It will generally be found that the intestine contained in the sac of a femoral hernia is dark-coloured and tightly nipped; it requires to be treated in accordance with the general principles that guide us in the management of hernia.

## UMBILICAL HERNIA.

By **Umbilical Hernia** or **Exomphalus** is meant a protrusion through the umbilical aperture. It occurs either in children or in adults.

**Umbilical Hernia in Children** is sometimes congenital; and, when so, it has happened that the protrusion has been included in, and accidentally strangulated by, the ligature applied to the umbilical cord. More frequently, however, it occurs shortly after birth, in consequence of the child straining or crying. In these cases it is readily recognised by a smooth, rounded, and tense tumour, starting forwards at the umbilicus, readily reducible on pressure.

The *Treatment* should consist in keeping the tumour reduced by the application of an elastic India-rubber belt, with an air-pad that presses firmly upon the aperture; or, should such a contrivance as this not be at hand, the reduction may readily enough be effected by applying over the aperture a piece of soap-plaster spread on amadou, upon which a well-padded slice of cork may be tightly strapped. It most commonly happens that, after pressure has in this way been kept up for some months, a radical cure results.

**Umbilical Hernia in Adults** most frequently occurs in women, especially those who have borne many children, or who are loaded with internal fat. It is by no means unlikely that a tendency to this disease is often established in childhood, but does not become developed until the abdominal muscles have been weakened and the umbilical aperture relaxed by the pressure of the gravid uterus.

Umbilical rupture generally attains a considerable bulk, and often acquires an enormous size; when large, it is commonly irregular or semilunar in shape, sometimes appearing to be composed of several distinct tumours. It is usually partly doughy and partly tympanitic to the feel, has a distinct impulse on coughing, and is readily reducible; not unfrequently it happens, however, that a portion of the rupture continues irreducible, owing to the existence of adherent omentum. The coverings of an umbilical rupture are usually extremely thin, consisting merely of the peritoneum, a layer of condensed fascia, which is often perforated at several points by circular openings through which the hernia protrudes, and the integuments containing the umbilical cicatrix, which is expanded over the part. The sac generally contains both intestine and omentum, but the stomach and other viscera have been included in it; and Murray has recorded a case in which the gravid uterus, at the eighth month of pregnancy, formed the contents of an umbilical hernia.

*Treatment.*—The treatment consists, if the hernia be reducible, in wearing a properly constructed truss; if irreducible, in applying a hollow cup-shaped pad supported by a bandage over the part. It not unfrequently happens that, in consequence of an indigestible or flatulent meal, an irreducible umbilical rupture in old persons becomes obstructed, the symptoms consisting of tension of the protrusion, with nausea and constipation. In these cases, much discrimination will be required to avoid confounding this passive condition of the tumour with acute strangulation of it. This may be done by attention to the rules laid down (p. 629, vol. II.). By leeching, fomentations, calomel and opium, and enemata, relief may usually be afforded. Should, however, the bowels not speedily act, and stercoraceous vomiting come on, the tumour continuing irreducible, it will be better to cut down upon it, and treat it as a strangulated hernia, dividing adhesions, and reducing the swelling; for, if it be left obstructed and unreduced, the whole tumour may run into a state of gangrenous inflammation, and then operative interference will be of little use. In such circumstances death usually results; but I have known the patient to survive the gangrene, the whole of a coil of intestine, the sac, and much mesentery and omentum sloughing away, and an incurable artificial anus resulting.

When an umbilical hernia becomes strangulated, as often happens in old irreducible tumours of this description, the symptoms are not usually very acute at first; but no time should be lost in effecting reduction, if possible, by the taxis, as they speedily assume an active and urgent character. If the taxis fail, the plan that I have usually found to succeed best has been to give the patient three doses of calomel gr. ij, and opium gr. j, one every second hour; at the administration of the second dose to apply an ice-bladder; to keep this on for four hours; and then to employ the taxis again, when reduction of some portion of the swelling will rarely fail to occur. Should this not succeed, the operation must be proceeded with without further delay, lest gangrene of the tumour set in.

**Operation.**—The parts covering an umbilical hernia are usually very thin in places, so that much caution is required in making the early incisions. The stricture should, if possible, be divided without opening the sac. This may usually be accomplished by drawing the tumour well down, and then making an incision in it about two inches in length over the neck at its upper part in the mesial line. If the tumour overlap here, it may be more convenient to make the incision by the side of the umbilical cicatrix, or even between the two lobes of the tumour; but as a general rule, the upper part is the best. After the division of the integumental structures, and often of a deep layer of fat, the end of the nail may be slipped under the edge of the sharp circular margin through which the protrusion has occurred, and, the stricture being divided away from the sac, and if possible in the mesial line, reduction may be readily and safely accomplished. Should the strangulation not be thus relieved, the sac must be opened, and any stricture divided from within. But the Surgeon should exhaust every means before he opens the sac of an umbilical hernia, especially of large size, the patient, I believe, rarely recovering when this is done—much less frequently, so far as my experience goes, than in other forms of hernia. Sometimes, after the external division of the stricture, it will be found that there is an internal strangulation in the hernia, the gut having slipped through an aperture formed, I believe, in the condensed fascia covering the sac; if so, the edge of this sharply defined opening may require division. Sir A. Cooper mentions an umbilical hernia forming two tumours, having a communication between them; and South relates a case in which the tumour resembled a figure of 8, a dense areolar band binding down the middle of the sac. In such cases as these, which are by no means uncommon, central constriction may require to be divided as well as the stricture at the neck of the sac. Adherent omentum had, I think, better be left in the sac in cases of umbilical hernia; and gangrenous intestine or omentum must be treated upon general principles. It is not often that strangulation of an umbilical hernia occurs during pregnancy; but, should this happen, the operation must be performed as usual; that condition does not complicate the case much, and instances are recorded by Sir A. Cooper, Lawrence, and others, of its successful performance at this period. After the division of the strictures and the reduction of parts, a large and very thick compress must be laid over the loose folds of integument in the site of the hernia, and be retained in position by a broad and firmly applied flannel roller.

## VENTRAL HERNIA.

By **Ventral Herniæ** are meant those protrusions of the intestine that occur through any part of the abdominal wall, except the inguinal, the femoral, or the umbilical apertures; they most commonly occur in the mid-line between the recti muscles, the linea alba appearing to have given way in this situation during parturition; and here they may attain an immense size. A case was once sent to me from the country, in which there was a long triangular gap through the upper part of the abdominal wall, extending from the umbilicus to the ensiform cartilage, through which a protrusion had taken place that was nearly as large as an adult's head. These ruptures have also been met with in the lineæ semilunares, and in the hypochondriac and iliac regions; and Cloquet describes a case occurring in the lumbar region. When these herniæ happen in the vicinity of the stomach, they are apt to occasion dyspeptic symptoms and much gastric irritation; but Lawrence is doubtless right in thinking that these symptoms do not arise from the implication of the stomach, but simply from irritation of it. These different protrusions have occasionally been met with as the result of injuries, by which the anterior abdominal wall has been lacerated; indeed they seldom, if ever, take place below the umbilicus, unless arising from a directly traumatic cause.

*Treatment.*—The treatment of ventral hernia must consist in supporting the tumour by means of a broad belt and properly constructed pad. Should it become strangulated, which I believe very rarely happens, owing to the width of the neck of the sac, the operation must be performed in the same way as for umbilical rupture, care being taken to divide cautiously the integuments, any aponeurotic investments, and the peritoneal sac if necessary; the stricture should always be divided upwards in the mesial line.

A rare kind of ventral rupture has been described by Guthrie and the German Surgeons, in which the abdominal wall has been absorbed or yielded to a considerable extent, forming a broad and expanded tumour, without any distinct neck or pedicle. Sometimes this tumour may attain an immense size, stretching perhaps down to the knees, and containing even the gravid uterus.

## PELVIC HERNIÆ.

OBTURATOR HERNIA.—This rare form of hernia, in which the protrusion of intestine takes place through the thyroid foramen, was first noticed by Garengeot, in the early part of the eighteenth century; and, since that time, about seventy cases have been recorded. Its existence has rarely been ascertained till after death; in fact, Lawrence seems to doubt the possibility of the recognition of the complaint during life, in consequence of the small size which the tumour attains, and its being covered in and compressed under the pectineus muscle. But several cases are on record in which it was recognised during life. It generally occurs in persons above the age of fifty; in consequence, according to Gurlt, of the participation by the muscular structures passing through the thyroid foramen in the general wasting of tissue which occurs at that time of life.

*Symptoms.*—In obturator hernia, the intestine descends through the thyroid foramen; the neck of the sac thus lies behind the horizontal ramus of the pubes. The symptoms have in some cases sufficiently resembled those of strangulated femoral hernia to lead able Surgeons to suppose they had to deal with the latter affection. In addition, however, to the ordinary symptoms of strangulation, there are two special signs which may lead to the suspicion of the existence of this hernia, if not to its positive diagnosis. The first of these is a slight fulness and hardness in the upper part of the thigh to the inner side of the femoral vessels, often very indistinct, yet giving to the surface of the limb a different outline from that which is observed on the other side. The other is, pain extending down the inner side of the thigh towards the knee; or even, as in a case referred to by Birkett, as far as the great toe. This pain has been noticed in a large number of the recorded cases, and is due to the pressure of the hernia on the obturator nerve: it may also be increased by pressure with the hand at the thyroid foramen. It does not extend to the testis; but it may, as happened in a case which I have seen, affect the thigh to such an extent that the patient, to relieve it, flexes the limb on the abdomen. Röser has recommended, as a means of diagnosis, an examination of the interior of the pelvis, *per rectum* in the male, and *per vaginam* in the female. Most reliance, however, is to be placed on the symptoms which I have described.

*Treatment.*—The taxis has been employed in a few cases. In one instance, Röser reduced an obturator hernia in this way, the patient surviving; but, in another case under his care, death took place, a portion of the walls of the intestine remaining strangulated. Werner was successful in an instance in which, in addition to applying pressure externally, he introduced his hand into the vagina, and employed traction backwards and upwards. Welsch of Herrenberg reduced an obturator hernia by external pressure; the patient was apparently doing well, when, in a few days, an abscess appeared at the site of the hernia, and he died in seven weeks. At the *post mortem* examination, the end of the vermiform appendix was found projecting through the thyroid foramen, with its tip laid open by the suppurative process.

In ten cases, an operation has been performed, followed in three cases by recovery, and in seven by death. The recoveries occurred in the practice of Obré, Bransby Cooper, and Lorinser of Vienna; and the deaths in cases operated on by Heath of Newcastle-on-Tyne, Nuttall of Leicester, Heiberg and Zahrtmann, Arntz of Ringkjöbing, Ulrich and Wilms of Berlin (two cases). In Obré's case, the patient was seized with symptoms of strangulation, but no tumour could be detected in any of the ordinary seats of hernia. "On uncovering the upper part of both thighs at the same time, the eye detected a slight degree of fulness in Scarpa's triangle on the right side; this triangle of the opposite limb was well marked with a hollow, or depression passing down its centre, but this was lost on the affected side, and the whole contour of this part of the limb was visibly fuller than that of the corresponding one. There was no tumour or circumscribed swelling; but, on standing over the patient, and using firm pressure with the ends of the fingers over the neighbourhood of the femoral artery, and a little below the saphenous opening, a distinct hardness could be felt (slight in its extent), giving an impression as if the sheaths of the vessels were being pressed on." Taking the dangerous state of the patient into consideration, Obré acted in accordance with the best rules of surgery; and, thinking that there might be a hernia deeply strangulated in the femoral canal, he made an incision downwards in this situation, but was disappointed on finding, when the saphenous opening was exposed, that there was no intestine confined there. As, however, a hardened structure could be deeply felt at the inner border of the opening, the fascia lata was exposed, and the pectineus muscle divided to the extent of about two inches, when a hernial sac of about the size of a pigeon's egg, and containing intestine, came into view. In this operation the saphena vein gave some trouble, lying in the course of the incision. The sac having been laid open, the stricture was divided upwards, during which part of the procedure the vein was accidentally cut, and required ligature; no other vessel was tied. The operation, which reflects the greatest credit on Obré's diagnostic skill and dexterity, was perfectly successful, the patient making an excellent recovery. In Bransby Cooper's case, the patient, a woman aged forty-nine, recovered from the operation, but died of bronchitis before leaving the hospital. In Lorinser's case, the existence of the tumour was detected by vaginal examination. On cutting down on the hernia (on the eleventh day of the symptoms) the intestine was found gangrenous. A fæcal fistula resulted, but subsequently closed; and the patient survived eleven months, dying at last of tuberculosis.

Considering the results which have followed the operation for obturator hernia, I think that when, in addition to the ordinary signs of strangulation, there are also present the altered contour of the limb (perhaps even distinct local swelling) and the pain which have been above described, these symptoms not only justify, but demand, that an exploratory incision be made through the structures overlying the obturator foramen so as to examine it. If a hernia be found there, it must be dealt with by the general rules already laid down, according to the state of the intestine.

Besides the obturator, various other pelvic herniæ may take place, as into the perinæum, the vagina, or through the sciatic notch. These various forms of rupture are of extreme rarity, and present many difficulties in their diagnosis.

PERINEAL HERNIA commonly occurs in the middle line, between the rectum and the bladder in men, or the rectum and vagina in women; but sometimes the protrusion has been known to take place by the side of the anus, or even in front of this. Of these various forms of rupture, many instances have been collected by Lawrence from different writers. The *Treatment* of such a hernia would consist in supporting the protrusion by means of a pad and bandage; as the mouth of the sac is very large, strangulation is not probable.

VAGINAL HERNIA has occasionally been met with; the tumour protruding through the posterior or upper wall of the vagina, and presenting the ordinary characters of this disease, such as impulse on coughing and reducibility. It may most conveniently be kept up by means of a sponge pessary.

PUDENDAL HERNIA has been described by Sir A. Cooper as very closely resembling vaginal rupture. The situation of the tumour may cause it to be mistaken for an inguinal hernia; but from this it may be recognised by the upper part of the labium and the ring being completely free, whilst a tumour presenting the ordinary characters of a rupture is situated in the lower part of the labium, and forms a prominence along the side of the vagina.

SCIATIC HERNIA.—This rare form of hernia has been described by Sir A. Cooper as passing through the sciatic notch, where it lies between the lower border of the pyriform muscle and the spine of the ischium. It lies in close relation with the sciatic nerve, and with the internal iliac vessels. In the case related by Cooper, the obturator artery passed above, and the vein below the neck of the sac. From the depth at which such a hernia would be seated, and its small size, it would probably escape observation during life; but, if detected, it might readily be retained by means of proper bandages and a pad. Should operation ever be required, the deep incisions must be carefully conducted, on account of the great importance of the parts surrounding the sac.

## DIAPHRAGMATIC HERNIA.

**Congenital defect of the Diaphragm** is occasionally met with.* It has consisted, in most of the recorded cases, of an aperture in this membrane, varying in size from an inch in diameter upwards; and even, in some rare instances, of an entire absence of one or both wings of the diaphragm. Through these openings, the contents of the abdomen have been protruded; the stomach and small intestines being most frequently displaced, and the spleen and liver having been found in the chest in a tolerably large proportion of the cases. The hernia has been mostly observed in children at or soon after birth; but in several instances the subjects have lived to adult age, the hernia at last apparently taking place accidentally. In some of these latter cases, however, it may be a question whether the opening in the diaphragm was not the result of an accident, perhaps some time antecedent to the occurrence of the hernia. The opening has generally been found in the left side; sometimes, however, on the right.

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* A most complete and interesting account of Congenital Diaphragmatic Hernia was published by Dr. Thomas Balfour in the *Edinburgh Medical Journal*, for April, 1869.

Diaphragmatic hernia is sometimes obviously of **traumatic** origin, being the result of a wound or laceration of the diaphragm. It usually attains a large size, and commonly contains the stomach or the transverse colon with a portion of the omentum, which forms a tumour in the thoracic cavity, encroaching upon the lungs, and pushing the heart to one side. The hernia is not enclosed in a peritoneal sac, but has been found partially enveloped by the pleura. It occurs generally on the left side of the chest, but cases have been recorded by Percy and others where the injury of the diaphragm was on the right side. The following case affords a very good instance of this rare affection.

A man, seventy-four years of age, was admitted into University College Hospital. About twelve months before, he fell into an area about ten feet deep; he believed that he injured his chest and head, as from that time he had suffered much from shortness of breath and occasional sensation of suffocation, had a hacking cough, and could not lie down without feeling some difficulty in breathing. At the time of the accident, he coughed up about three spoonfuls of blood. Ever since the accident, he suffered much from dyspeptic symptoms and constipation, though before he met with the injury he had experienced no inconvenience in this respect. About a month before admission, the difficulty in breathing increased; and four days before he came to the hospital, violent pain in the abdomen came on, and his bowels ceased to act, although he took a variety of aperient medicines, and had enemata containing croton oil. On admission, the abdomen was much distended, tense, and tympanitic, with pain around the umbilicus; the tongue was coated with whitish-brown, moist fur; the pulse was small, quick, and somewhat resisting; there was nausea, but no vomiting. The skin was cool, and the countenance anxious; the bowels had not acted for seven days, but he had frequent desire to go to stool. He was ordered an aperient draught every third hour. As this had no effect, he was directed to take calomel and elaterium pills, and to have turpentine enemata, which afforded him some relief, though they brought away no fæces. The patient became more restless, the skin cold and flabby, the countenance more anxious, the breathing shorter, and the abdomen more tympanitic, and he died two days after admission, and nine from the commencement of the obstruction.

*Examination of the Body twenty-four hours after death.*—The abdomen was distended and tympanitic, and the peritoneal sac contained about six ounces of fluid, with here and there patches of recently effused lymph. The small intestines were not distended: the large were greatly distended with flatus, the cæcum extending into the cavity of the pelvis; the ascending and the transverse colon were much distended, and it was found that a large loop of the transverse and of the descending colon had passed through an opening in the cordiform tendon of the diaphragm into the pleural sac, and was there strangulated (Fig. 689). The colon below the stricture was contracted, and entirely empty. On opening the thorax, the loop of intestine, fourteen inches in length, of a pale slate-colour, and distended with gas, was found in the left pleural sac. It reached as high as the fifth rib, touched the pericardium, and was overlapped by the free margin of the left lung. Where strangulated, it was of a darker colour than elsewhere. The opening in the diaphragm, through which it had passed, admitted little more than the point of the forefinger, and had a thin tendinous margin. The tenth and eleventh ribs, on the left side, were found to have been fractured; the latter was united by osseous matter, but the tenth rib, at the seat of fracture, had formed a false joint. Connected with this and with the intercostal space below it, was a firm adhesion about an inch broad and an inch and a half long, united by its other extremity in the protruded meso-colon and the diaphragm. The protruded meso-colon was firmly adherent to the upper surface of the diaphragm, close to the opening in it. The lungs were tolerably healthy. The right pleura contained three ounces, and the left eight ounces of serum.

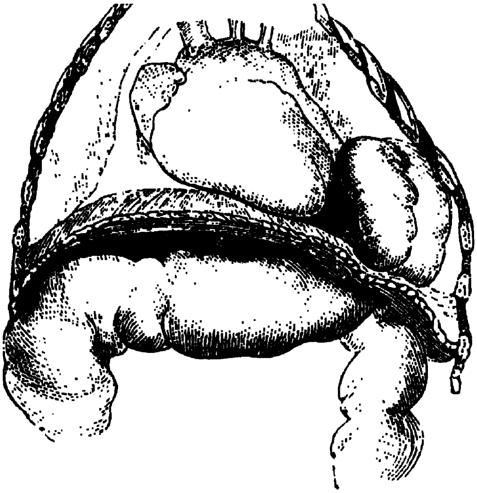


Fig. 689.—Diaphragmatic Hernia of Colon.

# CHAPTER LXIV.

## INTESTINAL OBSTRUCTION.

**Intestinal Obstructions** may be of two distinct kinds, the **Acute** and the **Chronic.** These must not be confounded with one another, as they are usually dependent not only upon very different conditions, but require different lines of treatment to be adopted for their relief.

ACUTE INTESTINAL OBSTRUCTION.—This condition may arise from five different causes. 1. It most commonly occurs by the formation of an internal hernia, which becomes suddenly strangulated, a portion of gut slipping through an aperture in the mesentery or omentum (Fig. 690), or becoming constricted by bands, adhesions, or diverticula, stretching across from one side of the abdomen to the other. 2. It may occur from invagination or intussusception, the upper portion of the intestine slipping into and being constricted by the lower. 3. It may be produced by a portion of gut becoming twisted upon itself, and thus forming a volvulus, owing to the mesentery or meso-colon being unusually long, and allowing a half twist to take place, in consequence of which complete obstruction occurs. 4. In other instances, symptoms of acute obstruction may arise in consequence of a malignant stricture gradually closing, and then at last becoming suddenly occluded. 5. Severe and even fatal intestinal obstruction may occur simply from a spasmodic contraction of the intestine, or as the result of inflammatory affections of the abdomen, without the existence of any mechanical lesion.

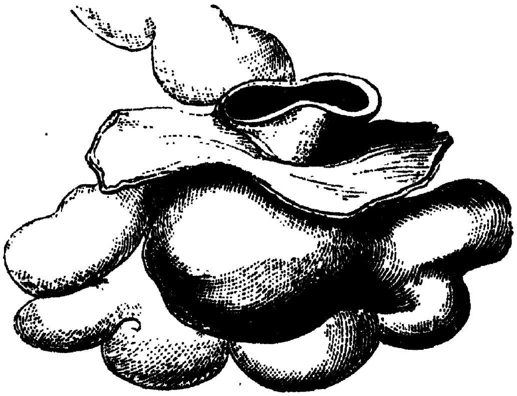


Fig. 690.—Intestinal Obstruction from Interna Hernia.

*Symptoms.*—The symptoms of acute intestinal obstruction, more especially when arising from a mechanical cause, such as the formation of an internal hernia, or volvulus, are always characterised by very marked vital depression. There is constipation from the very first; but this symptom is not the most prominent one, and those that result are evidently, as in an ordinary case of strangulated hernia, the consequence of the injury inflicted upon the intestine, rather than of the mere mechanical obstacle to the onward passage of the fæces. At the moment of the occurrence of the strangulation, the patient is usually seized with a sudden feeling of something wrong having taken place in the abdomen ; or he is struck with intense pain at one point. There may be sudden syncope, though most usually the depression of vital power does not amount to this. Vomiting speedily occurs ; at first of the contents of the stomach, but after a time of stercoraceous matter ; sometimes it assumes this form almost from the very first. The abdomen becomes swollen and tender, the intestines being blown up with flatus, giving rise to immense tympanitic distension, rolling over one another, and occasioning loud rumbling and gurgling noises. If the abdominal walls be thin, the rolling of the intestines may be distinctly felt, and in many cases seen, through them: and may sometimes be observed to be continued up to one spot, where it ceases. At this point an intumescence may sometimes be indistinctly felt corresponding to the seat of strangulation. If relief be not afforded, the sufferings of the patient become very severe, and his mental distress agonising ; the vomiting, perhaps, become less frequent, but the vital depression increases, and at last death results, usually about the sixth to the tenth day, though sometimes sooner, from exhaustion, peritonitis, and gangrene conjoined, the mind being clear to the last, and the patient's attention being intently and distressingly riveted upon the possibility or not of getting relief from the bowels.

CHRONIC INTESTINAL OBSTRUCTION.—This usually arises from one of three causes ; viz., 1, the gradual obliteration of some portion of the colon, in consequence of the malignant degeneration of its walls ; 2, the compression of the gut by a tumour growing near it ; or, 3, the obstruction of its cavity by the accumulation of large masses of hardened feculent matters.

The *Symptoms*, in the earlier stages of these cases, are commonly those that will be described as indicating stricture of the large intestine ; but, when once complete obstruction has come on, the constipation becomes the most prominent symptom. In some instances, this will occur without any antecedent leading to the supposition of the existence of stricture. There may be comparatively little constitutional disturbance at first, but the bowels cannot be made to act, and any attempt at forcing their operation by the administration of purgatives gives rise to sickness and much distress. During the progress of the attack, eructations, retchings, and even vomiting, are of frequent occurrence, but it seldom happens that this is stercoraceous till the very last ; there may be much tympanites, with rumbling and gurgling of the intestines, but most frequently the abdomen fills slowly and gradually, and these symptoms do not occur until after some days have elapsed. The distress of the patient does not depend so much on the length of time that the obstruction has existed, as on the amount of tympanitic distension of the abdomen. The greater this is, the more urgent will be the symptoms. In many instances, life is prolonged for several weeks, for five or six, even after complete obstruction has set in ; and in some cases a recovery may take place, even though a very considerable time have elapsed from the occurrence of the obstruction. In the case of a lady whom I attended many years ago with Mr. Powell, recovery took place, although there had been complete obstruction for upwards of five weeks ; and I have seen other cases recover in which from forty to forty-five days had elapsed before the obstruction was relieved.

DIAGNOSIS.—I. The diagnosis of the *causes of the obstruction* is of great importance; attention as to whether it assumes the acute or the chronic form, will throw some light upon the conditions that occasion it. It is often difficult to determine whether the obstruction is mechanical, or whether it depends upon a spasmodic or inflammatory affection of the intestine. The practice to be adopted in any particular case must at last be determined by a history of the symptoms, by a careful exploration of the abdomen and rectum, and by the light that can thus be thrown upon the question, as to whether the obstruction be dependent on causes that are removable or not by medical means. In many instances, the history of the case, the assemblage of strongly marked symptoms, and the result of abdominal and rectal exploration, enable the Surgeon to determine, without much difficulty, that the obstruction is dependent on causes that are not removable by any means short of operative interference. But, in other cases, no means that we possess enable us to arrive at a correct or even an approximate diagnosis. Cases are recorded that have ended fatally from obstruction in forty-eight hours, without sickness, fixed pain in the abdomen, or tympanites. These, however, are certainly exceptional, and do not bear upon the question as to the propriety of performing gastrotomy in those instances in which it can be satisfactorily determined that a mechanical obstacle, not removable by medical means, exists. That the diagnosis may so far be effected with tolerable certainty is evident, from the fact that, in all those cases of gastrotomy which have been of late years practised in this country, mechanical obstruction, irremovable by any but operative interference, had been diagnosed and was found.

The symptoms that will chiefly engage the Surgeon's attention are—1, the Duration of the Constipation; 2, the Occurrence of fixed Local Pain in the Abdomen; and 3, the Character of the Vomited Matters.

1. **The Duration of the Constipation** does not necessarily throw much light upon the cause. Indeed, if patients be naturally costive, constipation may last for a considerable number of days, or even weeks, without producing any very serious consequences. Most practitioners must have seen cases in which constipation has continued for three or four weeks, without destroying the patient. Johnson mentions a case, in which it lasted during forty-five days. In these cases, however, constipation has usually come on gradually, being, as it were, an aggravation of the patient's natural condition. It is the *character* rather than the mere duration of the constipation that is important. The sudden occurrence of irremovable obstruction, both of flatus and fæces, in persons otherwise regular in their bowels, and the sense of its dependence on a fixed cause, are points of importance, as tending to show that it arises from an acute mechanical condition. In acute internal strangulation, the constipation is always sudden, and is accompanied or speedily followed by other symptoms indicating obstruction.

2. **The Occurrence of Fixed Pain** is common to many conditions of the abdomen; though, when taken in conjunction with the sudden supervention of obstruction to the course of the fæces, with more or less tumefaction corresponding to the seat of pain, and more especially with the next symptom to which I shall advert, it is not without much value in the diagnosis.

3. **Character of the Vomiting.**—Even when the obstruction is not dependent on complete mechanical occlusion of the bowel, there may be incessant

vomiting, and the stomach may reject its contents as often as anything is introduced into it; but the vomiting will not be feculent in the majority of cases, however obstinate the constipation may be, and however long it may last. If, however, there be complete mechanical occlusion, feculent vomiting most commonly sets in early, frequently by the third day, or even sooner; and will continue until the cause of occlusion be removed. The vomiting, however, is not continuous, but will usually occur only after food has been taken into the stomach. It is true that feculent vomiting is not sufficient by itself to determine the diagnosis; and that it may occur in cases of pure spasmodic ileus, in which the obstruction is removable by medical means. Of this I have seen several instances,—the feculent vomiting being very persistent, and the patient presenting all the other symptoms that are usually considered to be dependent on internal strangulation; but eventually recovering under the use of opium, and other medical means directed to the relief of spasm, without the necessity of operative interference. It is, therefore, as necessary to bear in mind the occasional dependence of feculent vomiting on pure spasmodic ileus, or on other conditions that are removable by medical aid alone, as that it may be absent in cases in which the obstruction, whether seated in the small or in the large intestine, can only be relieved by surgical assistance. But a careful exploration of the abdomen and rectum, and a proper inquiry into the history of the case, will most generally prevent the Surgeon from being led into any serious error by trusting too implicitly to the presence or absence of this one symptom.

The following is a summary of the general diagnostic signs of the various conditions, leading to acute internal obstruction. 1. In *Internal hernia* the suddenness of the symptoms, the prostration or even syncope, fixed pain, and vomiting, will throw light on the condition. 2. In *Intussusception*, the early age, the fixed pain, with elongated tumour to be felt on palpation, and possibly through the rectum, with bloody mucous stools and tenesmus, are the chief signs. 3. In *Volvulus* the signs of internal strangulation, with very unequal distension of the abdomen, great tympanites on one side and flattening on the other, are met with. 4. In *Chronic stricture* suddenly occluded, the sudden aggravation of the previous long-continued difficulty in defecation will clear up the diagnosis.

II. After determining whether the obstruction be dependent on causes that are removable or not, the next most important point is doubtless to ascertain whether the obstruction is seated **in the large or in the small intestine.** In general, there may be no great difficulty in coming to an accurate opinion on this point, if it be borne in mind that, with the exception of volvulus, obstructions of the large intestines are most generally chronic, whilst those of the small are, in by far the majority of cases if not invariably, acute in their character. The earlier occurrence of feculent vomiting when the obstruction is in the small intestine, the greater tympanitic distention and bulging in the course of the cæcum and colon when it is seated in the large intestine (the amount of urinary secretion being, as was pointed out by Hilton and G. Bird, less in the former than in the latter case, owing to the diminished extent of intestinal surface capable of absorption of liquids), and the result of careful exploration of the rectum, will most commonly enable the Surgeon to decide this question with sufficient precision to guide him in the choice of an operation. Yet cases do occur in which, though the obstruction be seated in the large intestine, the symptoms are acute, and evidently not dependent on chronic obstructive disease, and vomiting is of early occurrence, the distension of the abdomen slight, the exploration by the rectum yields no result; and it is in cases of this description, presenting a train of symptoms of mixed and uncertain character, that the diagnosis of the precise seat of the obstruction cannot be made with sufficient precision to justify operation.

The most important point to determine in reference to the relief of intestinal obstructions by surgical operation, is whether the seat of the occlusion be above or below the lower end of the descending colon. If situated at or below this, relief may be afforded by "Amussat's operation," by which the colon is opened behind, and not through, the peritoneum. If above this point, except in those very rare cases in which the obstruction is in the transverse colon, it will be necessary to do "Gastrotomy," an operation by which the peritoneal cavity is opened, and thus the peril to the patient greatly increased.

1. When the obstruction is situated **below the descending colon**, exploration of the rectum will usually determine to what cause it is more immediately referable. Thus it may be owing to fæcal impaction; to strangulation of internal piles; to compression of the rectum by an over-distended bladder; or to an enlarged uterus, engorged and tilted backwards so as to compress and constrict the gut, and thus to lead to the supposition of the existence of tumour. If the intestinal obstruction be owing to one or the other of these causes, it may readily be relieved by appropriate treatment. It, however, more commonly proceeds from other conditions in this situation, that do not admit of relief except by operative interference; as from constriction, simple or malignant, of the upper portion of the rectum, or of the lower part of the sigmoid flexure of the colon, produced by the pressure of a pelvic tumour, or by a stricture from fibrous or cancerous degeneration of this part of the wall of the gut. In these circumstances, the obstruction may be as complete as in a case of internal strangulation, and the patient will inevitably perish unless relieved by operation. It is in this group of cases that relief may be given without interfering with the cavity of the peritoneum, by the operation of opening the descending colon in the left, or the cæcum in the right lumbar region, between the reflections of the peritoneum at the part where the gut is not covered by that membrane.

2. When the obstruction is situated **above the descending colon**, it almost always occurs in the small intestine, rarely in the cæcum or transverse colon, and may be dependent on various causes, some of which are removable, and others not, and of which preparations may be found in all the large pathological collections in London. Thus, it may be the result of internal strangulation, either occasioned by the small intestine falling into a pouch formed by the mesentery, or by the constriction of the gut by the passage across it of adventitious fibrous bands. It may be occasioned by intussusception, by the lodgment of biliary or other similar concretions, or by mere spasm of the small intestine, which may be so persistent as to prove fatal. This is, doubtless, a rare occurrence; but cases of the kind are on record, in which the only *post mortem* appearance that could be discovered has been a spasmodically

contracted ileum. The great practical difficulty in all these cases of obstruction, above the sigmoid flexure of the colon, is to determine the cause of the obstruction, whether it be of such a nature as may be removed by operation or not. In some of the cases mentioned, there may be special symptoms, which lead to a tolerably direct diagnosis. Thus, in intussusception, bloody and mucous stools, and the existence of an oblong indurated swelling, may give a clue; and in children, as the intussusception usually takes place through the ileo-colic valve, the mass of prolapsed intestine may often be felt in the rectum. In malignant or fibrous degeneration of the colon, the chronic nature of the disease, the history of the case, and rectal exploration with the bougie, may indicate the nature of the obstructing cause.

TREATMENT.—**Treatment of Acute Obstruction.**—This must necessarily be in a great measure determined by the diagnosis that is made as to its cause. Before proceeding to the employment of any measures, whether medical or surgical, in these cases, the Surgeon should never omit to institute a careful examination of the various abdominal and pelvic apertures for some of the more obscure forms of external hernia; for in cases of supposed internal strangulation, it has occasionally turned out, after death, that the patient had been labouring under a small femoral, obturator, or sciatic hernia. If such a condition be detected, it must of course be relieved by proper operative means. In the event of no such protrusion being detected, and from the general obscurity of the symptoms in these cases rendering an exact diagnosis in the earlier stages almost impossible, it is generally expedient to try the effect of proper medical treatment, which will sometimes, even in apparently hopeless cases, afford relief. The only plan of treatment that appears to me of any value is the continued administration of opium or of calomel and opium, with the free application of leeches to the abdomen, followed by fomentations. The opium should be given in the solid form, the dose being one grain every six or eight hours, either alone or combined with half a grain to a grain of calomel. This treatment will in all cases be of considerable service, and in some, even the most hopeless and complicated, will afford satisfactory results. In a very complicated case of intestinal obstruction which I attended with Garrod, this plan was eminently successful. A patient was admitted into the Hospital, having symptoms of internal strangulation; he had at the same time double inguinal hernia, and a small umbilical rupture, as well as the remains of a fatty tumour, which had been partially removed from the abdomimal wall many years previously. There were peritonitis with tympanites, stercoraceous vomiting, and much vital depression; but, as there was no strangulation existing in any of the external herniæ, and as there was no evidence as to the precise locality of the internal mischief, it was not thought advisable to have recourse to operation. The patient was accordingly treated with calomel and opium, when, on the tenth day, the obstruction gave way and the bowels acted, the patient ultimately recovering.

**Inflation of the Obstructed Intestine**, by the injection of air into the rectum, has been recommended in cases of intussusception, and has occasionally been practised with success. In two instances I have successfully had recourse to it. One was the case of an infant, a few months old, seized with symptoms of intussusception, whom I attended with Cousins. The other patient was a young lady about ten years of age, to whom I was called into consultation with Sir T. Watson, Dr. Murphy, and Dr. West; inflation was performed on the fifth day after the setting in of symptoms of acute intestinal obstruction, apparently dependent on intussusception. The proceeding was followed by perfect success: the child felt "as if a bone broke" in the abdomen, the obstruction was removed, and motions followed in three hours, though all the previous treatment had been unavailing. For the convenient performance of this operation, I have had an apparatus constructed, consisting of a circular double-action bellows, with a long vulcanised India-rubber tube, furnished with a stop-cock and rectum-tubes of different sizes for children and adults. Should this not be at hand, a well-fitted stomach-pump will answer the purpose. When the air is pumped in, it is doubtful whether it passes beyond the ileo-cæcal valve; but this is of little consequence, in children especially, in whom the inflation of the large intestine alone may be quite sufficient, the obstruction often consisting of the slipping of the portion of the small intestine through the ileo-cæcal aperture.

**Inversion of the patient**, and shaking him violently when in this position, is an empirical method of treatment that has occasionally proved successful in the relief of cases of internal strangulation of an obscure character. This rude operation is done as follows. The patient is anæsthetised; he is then taken by the legs and suspended over the shoulders of a strong and tall man, who, jumping up and down several times, violently shakes the inverted and unconscious patient. As the patient is hanging with his head downwards, and the other viscera as well as the abdominal are shaken up by this process, it need scarcely be said that care must be taken in its employment, and it would scarcely be safe, except in the young. I have known it to succeed in one case of obscure acute intestinal obstruction; and I have seen a case of fatal obturator hernia—unrecognised during life—in which, at the *post mortem* examination, it seemed probable that inversion and shaking would have effected reduction, and so saved the patient.

**Operation for Acute Intestinal Obstruction.**—When a patient is suffering from the symptoms of internal strangulation which resist medical treatment, and have not yielded to inflation or inversion—if it have been thought expedient to employ either of these means—he will almost to a certainty die, unless relief can be afforded by operation; and two great questions will at last press themselves upon the Surgeon's attention:—1, whether it is advisable to have recourse to operative interference; and, 2, when it is proper to undertake it. The solution of these questions is fraught with difficulty, and must always be a matter of the most anxious consideration to the Surgeon. It is not only that he knows that, if the patient be left unrelieved, he must necessarily die; but that he is aware that the only means of relief, gastrotomy, is probably nearly as fatal as the disease for which it is undertaken. But the difficulties that present themselves in the solution of the question are much increased by the great obscurity in diagnosing the cause of the obstruction, for in many cases it is absolutely impossible to determine with certainty whether it be dependent on ileus, or arise from mechanical causes; and by the fact that apparently desperate cases occasionally recover without operation. If, however, by attention to any of the points that have been pretty fully adverted to, it can be satisfactorily made out that there is an internal strangulation, and more especially if the intumescence occasioned by it can be felt, it will evidently be the duty of the Surgeon to give the patient his only chance by the division of the stricture. With regard to the time at which this should be done, the only general rule that can be laid down is probably the conclusion arrived at by Phillips; that operation is justifiable when three or four days have passed without any relief from ordinary means, constipation being complete, and vomiting of fæcal matters continuing.

**Gastrotomy** then may be required for the relief of acute intestinal obstruction, arising from, 1, internal strangulation of the small intestine in whatever way produced; 2, intussusception, or the slipping of the upper portion of a coil of intestine into, and its retention by, the lower; and 3, volvulus, or a semi-twist of the large intestine on itself.

The operation of gastrotomy is performed as follows. The room being well warmed, the patient should be laid on a high table, his legs being allowed to hang over the end of it, so as to afford a full view of the abdomen. The bladder having then been emptied, chloroform should be administered; and the Surgeon, taking his stand between the legs of the patient, proceeds to make the incision through the abdominal wall. This should, as a general rule, be carried through the linea alba directly in the mesial line below the umbilicus, more especially in children, and in thin subjects. If the patient be very fat, it might be necessary to extend the incision higher. It is very seldom necessary, and never desirable, to make the incision through the abdominal muscles to the side of the linea alba. By such a procedure the operation would in no way be facilitated, the wound would be more severe, the epigastric vessels endangered, and the after-liability to ventral hernia greatly increased. The linea alba then having been exposed, the incision must be carried through the abdominal wall until the peritoneum is reached; this must then be slit up by means of a probe-pointed bistoury guided by the forefinger of the left hand. The coils of small intestine will now probably protrude through the wound, curling over its edges; they must be drawn to one side, and be carefully supported by an assistant, who should press upon them with a soft towel, whilst the Surgeon searches for the obstruction. This he does by very carefully and gently tracing upwards the contracted and empty coils, which must necessarily be below the seat of obstruction, or by following downwards the distended intestine. If there be a hernial constriction formed by a dense adventitious fibroid band, he may divide the band that constitutes the stricture on a director by means of a probe-pointed bistoury or hernia knife, or break it through with the finger; or he may withdraw, from the aperture in the omentum or mesentery into which it had slipped, the constricted coil of intestine. If it be a case of volvulus, the colon may be untwisted, as in a case on which I operated in 1849. The intestines having been returned, the wound should be closed by the interrupted suture, and the application of some transverse strips of plaster; the patient must then have his knees bent over a pillow, and should be kept principally upon ice and barley-water. Opium must be continuously administered, and the case generally treated on the ordinary principles of abdominal wound. The mortality following gastrotomy for the relief of intestinal obstruction is, as might be expected, very high, amounting to about 80 per cent. Thus Ashhurst finds that, in 57 cases in which the operation was done, there were 11 recoveries only.

**Intussusception,** or the invagination of an upper into a lower portion of intestine, is a common cause of intestinal obstruction, especially in children. It may occur in three situations—viz., in the ileum, at the ileo-cæcal valve, or in the large intestine. The order of the frequency of its occurrence is in that of its seat, as just given. These intussusceptions vary greatly in length. They are short, not more than two or three inches in length when occurring in the small, 12 to 18 inches long when occurring in the large intestine. The intussusception may be acute or chronic, according as it is more or less tightly strangulated. When acute, the symptoms of urgent intestinal strangulation are well marked, usually accompanied by spurious diarrhœa, caused by bloody mucous or glairy discharge from the included bowel. In such cases the patient, especially if a young child, will die in the course of three to five days from collapse. If older, he may recover by the invaginated portion of gut sloughing away, and the continuity of the intestine being restored by the cohesion of the opposed serous surfaces at the neck of the invagination where the inversion has taken place. If chronic, the patient may live for some weeks until worn out by irritation and pain. The acute intussusception is usually situated in the ileum. The chronic is at the ileo-cæcal valve, or in the large intestine.

In all cases of intussusception there is a tumour at the seat of disease, caused by the doubling in of the inverted portion of gut. If the invagination be iliac and the patient thin, this tumour can be felt through the relaxed abdominal muscles. If the intussusception be ileo-cæcal, or in the large intestine, it can be felt by passing the finger up the rectum. In one case, related by Hutchinson, the intussusception was of such a length that the inverted ileo-cæcal valve was extruded for some inches beyond the child's anus, and had been mistaken and treated for a prolapsus.

*Treatment.*—There can be little doubt that spontaneous disentanglement occurs in many of the slighter cases of intussusception. In others, again, reduction of the invaginated bowel may be effected by the forcible injection up the rectum of tepid water, or the inflation of the bowel by air. These means, however, cannot be expected to succeed in any case of intussusception, except that of the large intestine. If it be at or above the ileo-cæcal valve, little good would result from such measures as these. If these means fail, the only chance of recovery without operation lies in the sloughing away of the invaginated portion of gut. And what is this chance by natural care? The answer given by statistics is as follows. J. L. Smith, of New York, collected the details of 50 cases; of these 7 recovered. Haven, of Boston, found that of 59 cases, there were 10; and Duchaussoy, that out of 135 cases, there were 29 recoveries. The chance of life by natural means, therefore, is about 18 per cent., or rather more than one in five—not a very hopeful one, truly. In these circumstances, Surgeons have naturally looked to gastrotomy, and the manual disentanglement of the invaginated gut, as offering a better prospect of life. And this operation has undoubtedly in many cases been followed by recovery, since, under the directions of Nuck, the first well authenticated successful operation of this kind was performed. Ashhurst has collected the particulars of 13 cases in which abdominal section was performed for intussusception. Of these five succeeded; and more recently the operation has been successfully practised by Hutchinson and others. But the prospect of success will greatly depend on the nature and seat of the intussusception. If the strangulation be very acute, and if the disease be seated in the ileum, the chances are not so favourable by any means as in the more chronic form of the affection, when the large intestine is the seat of the invagination. In these cases the gut is incarcerated rather than strangulated. There is, as Hutchinson has well pointed out, no hope of natural cure by gangrene of the included portion, and the patient will die, worn out by irritation and pain, unless relieved by operation.

As to the time at which the operation should be performed, it will necessarily vary greatly in the acute and the chronic cases of intussusception, and whether the obstruction is seated in the ileum or the large intestine. If the invagination be attended by acute symptoms of strangulation, and if it be situated in the ileum, the operation must not be delayed after a fair trial has been given to such means as injection, inflation, inversion, and opium. If the invagination be chronic and colic, the urgency for early operation is not so great, though the necessity be eventually greater.

The operation itself presents no difficulties. The incision should, as a rule, be made in the mesial line, and the tumour is a guide to the seat of the strangulation. When the invaginated gut is reached, it must be drawn out by a combined process of gentle traction and of kneading.

It need scarcely be said that if collapse, tympanites, or symptoms of gangrene have set in, no operation should be undertaken, and that it is always of very doubtful expediency in young infants. After the operation, the usual treatment of opium and milk and ice should be adopted.

**Treatment of Chronic Intestinal Obstruction.**—Gastrotomy is here not needed except in the one instance of chronic incarcerated intussusception, to which reference has already been made. With this exception, chronic intestinal obstruction will be found to arise from one of three conditions, viz.: fæcal impaction, compression of the rectum by pelvic tumour of some kind, or stricture of the large intestine.

*Fæcal impaction* is most common in elderly women. When it is suspected, the rectum should be explored, and if it be found to be blocked up by a rounded mass of indurated and impacted fæces, the Surgeon must condescend to undertake the duties of the nightman, and empty the human cloaca of its fetid accumulations. This is best done by anæsthetising the patient, then dilating the sphincter ani with the hand, breaking down the indurated mass with an iron spoon or lithotomy scoop, and washing it away by copious enemata.

If the obstruction arise from the gradual compression of the rectum by an *intrapelvic tumour*, or from the slow constriction of it or the colon by *malignant disease of the walls*, purgatives will be worse than useless; they will irritate, will often induce vomiting, and will always considerably increase the patient's distress, and should not be repeated. The patient should be kept quiet in bed, and have a nourishing diet: one leaving little residue is to be preferred,—the best consists of beef-tea, eggs, and a small quantity of brandy; and the passage should be opened by enemata, and the introduction of the tube of a stomach-pump. If these means do not succeed, and if the obstruction, as is almost always the case in these chronic instances, be seated in or below the sigmoid flexure of the colon, the intestine must be opened at a point above the seat of disease.

**Colotomy.**—The operation required to give exit to the intestinal contents, is of two kinds. In one the intestine is opened in the left iliac fossa, by cutting through the peritoneum covering it. In the other it is opened in the loin by cutting between the layers of the meso-colon, being thus exposed where it is uncovered by peritoneum.

*Littré's Operation.*—The first operation, or Littré's, as it has been called, was proposed by a Surgeon of that name, in 1710, who advised that in these cases the sigmoid flexure of the colon should be opened from the left iliac region; but it was not until the year 1776 that any operation of the kind was performed, when Pillore, a Surgeon of Rouen, was the first to make an artificial anus on the adult, for relief of retention of fæces; this he did, not according to Littré's method, but by opening the cæcum from the right iliac region. Fine, of Geneva, in 1797, opened the transverse colon from the umbilical region, in a case of retention of fæces produced by scirrhus of the upper part of the rectum.

Although these operations serve to fulfil the indication of relieving the retention of the fæces, they are all defective in one most important respect; for, as the peritoneum must in all of them of necessity be wounded, an intense and frequently fatal peritonitis is the inevitable consequence. It was to avoid this serious complication that Callisen, of Copenhagen, in 1796, proposed opening the colon from behind, in the left lumber region, where it is not covered by peritoneum. He once attempted this operation on the dead body of a child; but, failing in his endeavour to reach the intestine without wounding the serous membrane, he seems to have relinquished all further idea of it; and it was subsequently rejected as impracticable by all writers on surgery who treated of this subject.

*Amussat's Operation.*—The operation of colotomy proposed by Callisen, but first practised and perfected by Amussat, is one of the most important additions to modern operative surgery, and affords an admirable illustration of the important practical application of an apparently trivial anatomical fact, viz., the relation of the layers of the meso-colon to the descending colon.

Amussat, at the time when he was attending the celebrated Broussais for that scirrhous affection of the rectum of which he ultimately died, was led to reflect on the resources that Surgery offers in similar cases; and after making some experiments on the dead body, with the view of contrasting the merit of the different operations that have been proposed for the formation of artificial anus in cases of obstruction of the large intestines, he became convinced that the operation proposed by Callisen, if somewhat modified, was not only practicable, but safe. He soon had an opportunity of putting this opinion to the test of experiment in 1839, in a private case, at which he kindly invited me, then a student in Paris, to be present; and since this time the operation has taken a recognised position in Surgery.

It is not only for the relief of chronic intestinal obstruction that Amussat's operation is now performed.

Colotomy may be required for the following conditions :—

1. Intestinal obstruction below the descending colon.

2. Intense pain in defæcation, in ulcerated cancer of the large intestine or rectum.

3. Cancerous fistula between the rectum and bladder.

4. Congenital absence of the rectum (p. 701).

The following is the way in which **Colotomy by Amussat's operation** may be performed. A transverse incision is to be made two finger-breadths above and parallel to the crista ilii of the left side, or rather in the middle of that space which is bounded by the false ribs above and by the crista ilii below; the incision should commence at the external margin of the erector spinæ, and extend outwards for about four inches. The spinous processes of the lumbar vertebræ, the crest of the ilium, and the last false rib, are the principal guides. The superior margin of the crista ilii is, however, the safest of these; and the transverse incision may be said to correspond to the middle third of this part of the ilium (Fig. 691). According to the rule laid down by Allingham, the centre of the incision should be exactly half an inch behind a line drawn vertically upwards from the mid-point between the anterior and posterior superior spines of the ilium. It is just under this that the colon will be found. After the skin and the more superficial tissues have been divided, the muscular layers of the abdominal wall are next to be incised as they present themselves; if necessary, the external border of the quadratus lumborum may also be cut across. These structures should be divided to the same extent as the incision of the skin, otherwise the Surgeon will continue to dig a deep and conical pit, and will certainly fail to recognise at the bottom of it the gut of which he is in search. The dissection is then very carefully to be carried through the fine but firm layers of areolo-adipose tissue, which lie immediately upon the intestine. When the patient is fat, these are loaded with adipose matter; when thin, they are semi-transparent and membranous, closely resembling peritoneum, for which, indeed, they may readily be mistaken. These layers immediately overlie the colon, which may usually be felt and seen to bulge through them. After their division, the colon will, in general, readily present itself, and may at once be recognised by its greenish colour and distended appearance (Fig. 692). The operation may then be completed by passing a tenaculum, or a needle armed with a strong waxed thread, into the most projecting part of the

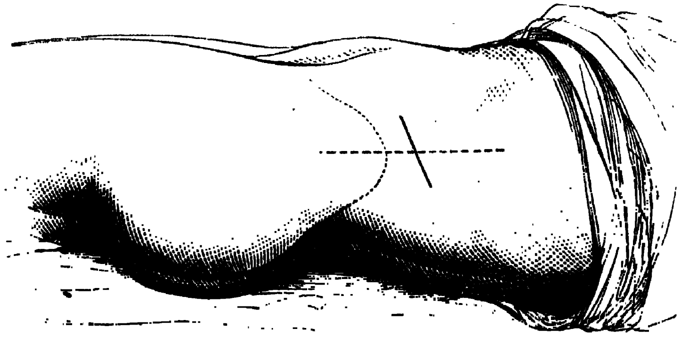


Fig. 691.—Line of Incision for Lumbar Colotomy. Dotted line indicates situation of Descending Colon.

gut, and by this means drawing it to the surface of the wound, in order to prevent it from shrinking or sinking back when opened. It is now to be punctured with a large trochar or bistoury; and its contents having been evacuated, the sides of the opening in the intestine are to be fixed to those of the incision in the skin by four or five points of suture, so as to prevent the contents of the bowel from being effused into the areolar tissue of the wound (Fig. 693). It is of importance to draw the colon well forwards before opening it, in order to prevent its contents from being effused into the loose areolar tissue of the wound, when they may set up considerable irritation and retard the union of the parts. In order to prevent that accident, the following procedure may be adopted with great advantage. When the gut is exposed, two long silk sutures may be passed through it transversely parallel to the sides of the wound. Each suture should have a needle at each end. The four needles should then be passed through four points of skin, two in the upper and two in the lower side of the wound. The gut may then be opened between the two sutures, the finger introduced, the loops pulled out and divided and rapidly tied. By this plan much time is saved, and the fæcal matter prevented from running into the wound. If the patient be very fat, the operation is proportionately difficult on account of the depth of areolo-adipose tissue lying in front of the quadratus, which requires to be very carefully dissected through before the gut can be reached. This step of the operation will be much facilitated by dividing the deeper seated tissues in a crucial manner, so as to give the operator more space.

After colotomy, the patient will derive much comfort from taking powdered charcoal. It not only deodorises, but also tends to harden the fæces. When recovery has taken place, the anal aperture in the lumbar region may be kept supported and closed by means of a truss with a large pad.

When the operation is practised on the dead body, it will be found on dissection that the following are the parts cut through. After the skin and areolar tissue, the latissimus dorsi will be seen divided towards the posterior third of the incision, and the obliquus externus in the anterior two-thirds of it: the obliquus internus and the transversalis, sometimes the quadratus lumborum, the areolo-adipose tissue which immediately covers the intestine, and finally the colon itself, come into view. The colon will usually be found a little behind a point that lies midway between the anterior and the posterior spines of the ilium. After the more superficial incisions have been made, the surest guide will be the line of condensed fascia which forms the anterior edge of the sheath of the quadratus, and which lies between that muscle and the transversalis. This line may always readily be distinguished by its buff colour

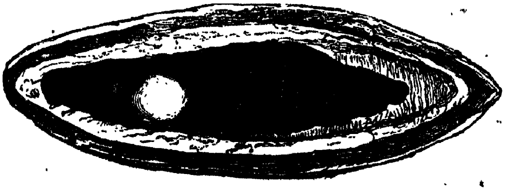


Fig. 692.—Incision in Left Lumbar Region in Amussat's Operation.

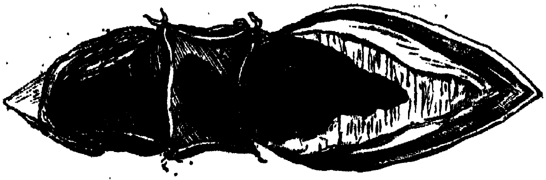


Fig. 693.—Colon Opened and Stitched to Sides of Incision.

from the surrounding muscular structures. Very few vessels or nerves are wounded, as they for the most part run parallel to the line of incision; whereas, if the vertical incision of Callisen were adopted, they would necessarily be cut across. Different Surgeons have variously modified this operation by making the incision vertical or semilunar instead of transverse.

Amussat's operation may be required in a totally different set of cases from those of intestinal obstruction, viz., in cases in which there is no distension of the gut, but in which the patient is worn out by the sufferings induced by the passage of feculent matters over an ulcerated cancer of the rectum, or in which great distress and discomfort arise from the perforation of the bladder or vagina by a rectal cancer, and the consequent passage of fæces into these cavities. In cases such as these, the object of the operation is not to relieve distension, but to give ease to the patient, to mitigate his sufferings, and consequently to prolong his life in comfort, by diverting the passage of the fæces from the ulcerated surface through the opening in the lumbar region, and thus removing the main cause of his sufferings. It has proved most successful in affording the desired relief. But in such cases, the operation is somewhat difficult of execution; for, on account of the contracted state of the colon, that intestine recedes behind the quadratus lumborum, and the folds of peritoneum nearly surround or invest it; and it is so covered in by fat and areolar tissue, that a very cautious dissection is required to expose it without wounding the peritoneum. The difficulty may to a certain extent be lessened by throwing up a large bland enema just before the operation, so as to distend the gut somewhat forcibly.

Lastly, it may be required in cases of imperforate anus in children in whom the rectum is absent, so that the gut cannot be reached through the perinæum. In operating on the newly born infant, it must be borne in mind that the kidney is very large, extends far outwards, and is enveloped in very little if any fat, and that the meso-colon is often so long that there may be a difficulty in opening the gut without wounding the peritoneum. I am disposed to think that in these cases it may be better to open the cæcum in the right flank than the descending colon in the left (see page 701).

**Comparison of Littré's and Amussat's Operations.**—When we compare the different operations that have been proposed for the formation of an artificial anus, it will be found that Callisen's, as modified by Amussat, is the one to which the preference must be given; for by it alone the peritoneum is not wounded, and thus the inflammation of that membrane, which is a necessary and often a fatal consequence of the other operations, is avoided. Beside this advantage, which is of the very greatest importance, Amussat's operation presents several other claims to our notice. As only one side of the colon can be drawn forwards, and not a knuckle of it, as would be the case if the small intestines were operated upon, it is evident that the spur-like process, which has been described by Dupuytren, must exist to a very small extent; and, consequently, if the artificial anus should ever become useless, the natural passage for the fæces having been re-established, it could readily be closed up. If, however, the peritoneum should be accidentally wounded in the attempt to reach the colon from behind, even then this operation would be preferable to that of Littré; for, the cavity of the abdomen having been opened at its most depending part (in the recumbent position), the fæcal matters would have much less tendency to be effused into it, than if it were opened in front. In respect of not wounding the peritoneum, this operation closely resembles that of puncturing the bladder above the pubes, and below the reflexion of that membrane. There is, however, one important difference between the two operations, which may influence the result; in the one case, as the patient lies upon his back, the urine has a tendency to stagnate in the wound, being obliged, in order to escape, to mount against its own gravity; whilst, in the other case, the fæcal matters find a ready exit from a wound situated in a depending part.

Cæsar Hawkins has collected and analysed 44 cases, in which an artificial anus has been formed by opening the intestine; in 17 of these the artificial anus was made through the peritoneum, and in 27 behind that membrane; but for various reasons, which are stated at length in the paper, Hawkins excludes 5 of the cases of peritoneal section, leaving only 12 to compare with 26 cases of operation behind this membrane. Of the former he finds that 7 died and 5 recovered; the recoveries amounting, therefore, to only forty-one per cent. in the cases of this category; whilst of the 26 cases where the peritoneum was uninjured, 10 died and 16 recovered; the proportion of recoveries in the cases of this category amounting to sixty-one per cent. Though the large intestine was opened in all these cases, the operation was performed on the *right* side in 10 instances; in 4 cases the right colon and cæcum were opened through the peritoneum, and of these all died; whilst of the remaining 6, in which the right colon was opened behind the peritoneum, 4 recovered. The preference, therefore, as Hawkins observes, on the right side, is certainly due to the lumbar operation. It is remarkable, however, that in the operation on the *left* colon, the results are somewhat different; for, of 8 cases in which this intestine was opened through the peritoneum, 5 recovered and 3 died; whilst of 20 cases in which the lumbar operation was performed, 11 recovered and 9 died. Hawkins observes, that the inequalities of the numbers appear, however, to leave the question as to the mode of operating on the descending colon still undecided; and that an operator is justified in selecting whichever situation he thinks best for the formation of an artificial anus on the left side of the body; still, for the reasons that have already been given, there can be no doubt whatever that Amussat's is very decidedly preferable to Littré's operation. In those cases in which death has resulted from Amussat's operation, peritonitis does not appear to have exercised any material influence; and the fatal result seems rather to have depended on the influence of previous disease on the constitution of the patient, or on changes taking place in the diseased bowel, than on the operation itself, which appears occasionally to have been uselessly done at the last extremity. We should, therefore, have less hesitation in performing the extraperitoneal operation in an early stage of those cases in which it is called for, than we should if the section itself were attended with any serious risk to the patient's life.

# CHAPTER LXV.

## TAPPING THE ABDOMEN.—TUMOURS OF THE GROIN.

### TAPPING THE ABDOMEN.

THE abdomen often requires **Tapping**, either for ascites or for encysted dropsy. This operation, which is one of the simplest in surgery, may be performed as follows. The bladder having been emptied, the patient is seated on the edge of the bed or of a large chair, or if very weak lies on the side, and has a broad flannel roller, split at each end to within six inches of the middle, passed round the body in such a way that the untorn part covers the front of the abdomen, whilst the ends, which are crossed behind, are given to an assistant on each side, who must draw tightly upon them as the water flows. The Surgeon then, seating himself before the patient, makes a small incision with a scalpel into the mesial line about two inches below the umbilicus, and through the opening thus made he thrusts the trochar; as the fluid escapes, the patient often becomes faint, but this may commonly be guarded against by continuing to draw upon the bandage so as to keep up good pressure in the abdomen. After all the fluid has escaped, the aperture must be closed with a strip or two of plaster supported by a pad and bandage.

The incision through which the trochar is thrust need not enter the peritoneum, though if it do it matters little. The trochar itself must be of full size, with a well-fitting cannula. Sometimes it is convenient to have one fitted with a stop-cock, to the end of which a vulcanised India-rubber tube, as represented Fig. 657, p. 569, may be adapted, by which the fluid is carried quietly and without splashing into the pail destined to receive it. Should the particular character of the accumulation of fluid in encysted dropsy not allow its withdrawal by an aperture below the umbilicus, the abdomen may be tapped in any other convenient situation, except in the course of the epigastric vessels.

### TUMOURS OF THE GROIN.

Tumours of various kinds may develope primarily in the groin, or descend into it from the abdomen. They are of the following kinds:—1. Enlargement of the Lymphatic Glands. 2. Abscess in or around those glands. 3. Abscess descending into the groin from the abdomen—Psoas, Iliac, Pericæcal, Perinephritic, &c. 4. Varix of the Saphena Vein at its entrance into the femoral, 5. Aneurisms of all kinds. 6. Osteo-Aneurisms. 7. Cystic Tumours, bursal, and developing in the muscular structures. 8. Simple Solid Tumours, as fatty, fibro-cellular, fibro-plastic, and fibroid. 9. Malignant Tumours, primarily developing in the soft structures in this region, extending into it from the bones, or secondarily from contamination of the glands. 10. Herniæ of different kinds—inguinal, femoral, and obturator.

DIAGNOSIS.—In effecting the diagnosis of these various tumours, we must first distinguish the pulsating from those that do not pulsate. The **Pulsating Tumours** must either be aneurisms, osteo-aneurisms, or cancers or abscesses with communicated pulsation. The diagnosis of these different forms of disease has already been so fully given at pages 28 and 210, vol. II., that I need not enter upon it here.

The **Non-Pulsating Tumours** are to be divided into two great classes, viz., the *Reducible* and the *Irreducible*.

The *Reducible Tumours* of the groin are either hernia, varix of the saphena vein, or abdominal abscess presenting under Poupart's ligament. The diagnosis of these different conditions is given at pp. 659, 660, vol. II. These all have an impulse communicated to them in coughing.

The *Irreducible Tumours* of the groin have further to be divided into those that contain *Fluid* and those that are *Solid*.

The irreducible tumours *containing Fluid* are either abscesses in or around the lymphatic glands, or cystic growths of various kinds. The diagnosis here is easy: the irregular hardened outline of glandular abscess, its rapid development, and softening from a previously indurated state, will distinguish it from the tense, clearly defined outline, smooth and elastic feel of the slowly developing and very chronic cystic growth. In irreducible hernia the impulse on coughing, the gurgling, and other peculiar signs characteristic of that disease, will prevent the possibility of error in diagnosis.

The *Solid* tumours in the groin may either be simple or malignant. The history of the case, the feel of the tumour, the rapidity of its progress, the extent of contamination of neighbouring parts, and the other signs that serve as diagnostic differences between simple and malignant growths, will enable the Surgeon to effect the diagnosis with sufficient accuracy.

The *Treatment* of many of these tumours, such as abscess of various kinds, aneurism, varix, and hernia, has already been so fully considered in the various chapters devoted to these diseases, that I need not enter upon it here. But the question of operating for the *removal of cystic or solid tumours* of the groin, is one that presents several special points for consideration. These are, the relations of the morbid mass, 1st, to the femoral vein; 2nd, to the femoral artery; and 3rd, to the abdominal cavity. If the tumour lie upon or compress the femoral vein, œdema of the foot and leg will be the result; and, should the compression have been prolonged and very chronic, this œdema may assume a semi-solid character, so as to occasion a condition of the limb closely resembling elephantiasis. Although an intimate relation such as this between the tumour and vein would obviously inculcate the necessity for extreme caution, it need not necessarily preclude the idea of operating for the removal of the tumour, which may possibly be altogether above and unattached to the sheath of the vessels. I once successfully removed a nævoid and lipomatous tumour of many years' standing, in a case where the limb was in a state of spurious elephantiasis from compression of the femoral vein, but the vessel was not involved in the growth. If the femoral artery be compressed to such an extent as to interfere with the circulation through the lower part of the limb, it will most probably be found that the tumour dips under or surrounds the vessel, so as to render removal impracticable. The mere overlying of the artery by a freely movable mass, without any compression of the vessel, need not preclude operation. The growth figured p. 345, vol. II., was of this kind. The connection of the tumour with the abdominal or pelvic cavities under Poupart's ligament, or through the obturator foramen, must be most carefully examined. Should this exist, or even be strongly suspected, operation is necessarily quite inadmissible.

# CHAPTER LXVI.

## DISEASES OF THE LARGE INTESTINE AND ANUS.

### CONGENITAL MALFORMATIONS.

**Congenital Malformations** of the anus and rectum are by no means unfrequent, and are of considerable importance; for, if unrelieved, they must necessarily be the cause of speedily fatal intestinal obstruction. They may exist in various degrees, which may most conveniently be arranged under the following heads.

**Narrowing and Partial Closure of the Anus.**—The canal continues pervious, but not sufficiently so to allow of the bowels being completely emptied, the contraction usually merely admitting a full-sized probe. In some cases the obstruction appears to depend upon constriction of the anal orifice, in others upon an imperfect septum stretching across it.

*Treatment.*—This consists in notching the contracted anus with a probe-pointed bistoury, and then introducing a sponge-tent, so as to dilate it to the proper size, to which it must be kept by the occasional introduction of a bougie.

**Complete Closure of Anus.**—The anus may be completely closed by a membranous septum stretching across it, usually having a raphe along the central line, and a slight depression, through which the dark meconium can be seen, and on which an impulse can be felt. This constitutes perhaps the most common form of malformation that is met with.

*Treatment.*—In this variety an incision must be made through the septum along the middle line, and this again cut across on each side, when the meconium will freely escape. The four angular flaps that are left must now be removed, and the aperture kept open by the introduction of a well-oiled plug.

**Occlusion of Rectum above the Anus by a Membranous Septum.**—The anus may remain open; but, at a distance of about half an inch or an inch from its aperture, the rectum will be found occluded by a perfect membranous septum stretching across it. This is a rare and somewhat puzzling kind of malformation, as in it the infant will be found to labour under intestinal obstruction, and yet, on examination, the anal orifice will be found perfectly formed, and thus the Surgeon may be misled as to the seat of the obstacle. He will, however, detect it by introducing a probe or the end of his little finger into the anus.

*Treatment.*—The operation, of which the following are the details, will be found to be successful.

1. The child is put in the lithotomy position. 2. A trochar-cannula is then passed down to and pressed against the septum. 3. The stylet is then passed

down the cannula and through the septum. 4. The trochar being pushed into the bowel, is withdrawn, and the cannula left in. 5. A probe is passed through the cannula, which is then slipped out over it and along the probe, or a director which may be substituted for it, a narrow-bladed pair of dressing forceps is pushed up and opened out so as to dilate the opening in the septum. During this process, the retained fæces will have escaped. The aperture must be kept free by the occasional introduction and expansion of the forceps or of a laminaria tube.

It is important to observe that, although the anus may be perfectly formed and patent, with a canal above it about half an inch long, the rectum may be entirely absent, the sigmoid flexure terminating in an immense cloaca opposite the sacral prominence. In such cases it is of course impossible to reach the gut through the anus. In a case of this kind, in an infant four days old, in which I was unable to reach the gut through the anal aperture, I performed lumbar colotomy.

**Complete Absence of Anus.**—The anus may be completely absent, being blocked up by a dense mass of fibro-cellular structure, from half-an-inch to an inch in thickness, above which the rectum terminates in a kind of *cul-de-sac*.

*Treatment.*—An incision about an inch in length should be carefully made, from the point of the coccyx forwards, and the dissection carried down until the gut is reached ; this must then be punctured, and the meconium allowed to escape. If the cut surface be left to granulate, with a plug of lint merely interposed between its sides, it will gradually contract, and degenerate into a fistulous opening, through which the meconium will escape with difficulty ; and, as this track is not lined by a mucous membrane, the probability is that the irritation set up along it by the intestinal matters will ultimately prove fatal to the child. Indeed, it commonly happens in these cases that death results in a few days, from irritation occasioned by the absorption of the excreted fluids. In order to obviate this source of danger, Amussat thought of bringing down the mucous membrane of the bowel to the anal orifice, and fixing it there by sutures, so as to afford the meconium a mucous canal to pass through, and thus to prevent the diffuse inflammation which is apt to take place in the areolar tissue of the pelvis, by the contact and absorption of the effused matters. In many cases it is by no means easy to do this, but it should always be attempted, as I believe the whole safety of the child depends upon this being carried out. For some considerable time after the operation, the aperture should be kept dilated by means of bougies ; a gum-elastic or pewter tube, through which the fæces are allowed to escape, may be fixed in the part.

**Closure of Anus with Absence of Rectum.**—It has already been stated that in some cases of perfect formation and of patency of the anus the rectum is absent, but more commonly the anus is closed when the whole of the rectum is wanting ; the intestine (colon) terminating in a large and expanded pouch, situated high up at the brim of the pelvis, opposite the sacral prominence. A case of this kind differs from the last only in the extent of the occlusion, and cannot indeed be distinguished from it until the Surgeon has made an incision in the site of the anus, and has failed to reach the gut at the usual distance.

*Treatment.*—Three courses present themselves to the Surgeon. 1. The colon may be opened in the left iliac region; 2. It may be reached in the left lumbar region; and, 3. An opening may be made into it through the perinæum.

1. **Iliac Incision.**—The only *advantages* that the iliac incision or Littré's operation presents, are, that it is an operation easy of performance; and that, whether the Surgeon reach the colon or not, he is certain to hit upon some part of the intestinal tube which may be drawn forwards and opened.

The *objections* to this operation are, the inconvenient situation of the artificial anus; the great danger that must necessarily result from wounding the peritoneum; the chance of not finding the sigmoid flexure; and, as has often happened, of being obliged to open that portion of the small intestine which first presents itself.

The *mortality* after this operation is very great. Amussat states that, of twenty-one children thus operated on, only four ultimately recovered. Rochard, of Brest, however, writing in 1859, speaks of twelve cases as having occurred in the practice of himself and other Surgeons in that town, in seven of which the operation was followed by recovery.

2. **Lumbar Incision.**—The lumbar incision, or Amussat's operation, has now been several times successfully practised on imperforate children.

The *advantages* of this operation consist not only in the artificial anus being situated at a more convenient spot than in Littré's operation, but more especially in the possibility of opening the colon in this situation without wounding the peritoneum.

The *objections* to this operation, as applied to imperforate children, lie in the frequent co-existence of malformation or malposition of the colon with absence of the rectum, and in the impossibility in many cases of determining, before proceeding to operate, whether the anus is only occluded by a membranous septum, or whether the rectum is absent as well. If it could be ascertained beforehand that, though the rectum be absent, the descending colon occupies its normal position in the left lumbar region, I think it probable that the lumbar incision would be attended with less danger than any other operation that could be practised; but, in the absence of this knowledge, it would scarcely appear to be justifiable to have recourse to it, as the colon might not be found, and the anus might merely be covered by a dense membranous septum.

3. **Perineal Incision.**—The perineal incision has the advantage of being in the natural situation of the anus, and of being easily practised and perfectly successful in all those cases in which the anus only is imperforate, the rectum being present. It is in those cases only in which there is congenital absence of the rectum that this operation is difficult of performance, and uncertain in its results. The dissection requires to be carried with caution to a considerable depth along the mesial line; the Surgeon taking the curve of the sacrum and coccyx for his guide, and, bearing in mind the relations of the bladder and large vessels in the neighbourhood, carefully proceeding in search of the gut, which may be found at a considerable depth from the surface. The danger of wounding the bladder must also be considered, and may be materially lessened by emptying this viscus by pressing over the pubes before commencing the operation. In four instances of this kind on which I have operated, it was

necessary to proceed to a depth of at least one and a half or two inches before the bowel was reached ; which, on account of the narrowness of the wound and the small size and important relations of the parts, is not an easy matter. If it could be ascertained before proceeding to operate, that the rectum is absent, it might be wiser to search for the bowel in the lumbar region. But, as the Surgeon has no means of ascertaining, before making his incision, whether the rectum be one inch or three inches from the surface, he must cut into the perinæum in order to obtain the necessary information ; and if once he have penetrated to such a depth as to pass beyond the levator ani muscle, or into the deep fasciæ in this situation, a great portion of the immediate danger of the operation will have been incurred, and few would think it advisable to leave the perineal operation unfinished, and expose the child to the additional risk of opening the colon in the lumbar region. Yet, if he have gone as deeply as he dare venture, and have not encountered the bowel, there is no alternative but to open the intestine through the abdominal wall, or to leave the child to its fate. In this alternative, Amussat's operation should be performed. This has actually been done, and with success. I saw, some years ago, a young gentleman eight years of age, who had thus been operated upon in Mexico for congenital absence of the anus and rectum. An incision had first been made in the perinæum, but, no intestine being met with, the colon was opened in the left lumbar region. The boy was in good health, well nourished, had no great trouble with the artificial anus, which was covered with a truss pad, and only suffered occasional inconvenience from prolapse of the mucous membrane. There was a kind of sphincter-like action in the muscles about the orifice, by which the finger was gripped.

I have several times operated in this way on imperforate children ; but in all instances unsuccessfully. In one case, there was an anal aperture, but with complete occlusion of the rectum. I operated on the fourth day, first attempting to reach the gut through the anus ; but, failing in this, performed the lumbar operation on the left side.

There is one point in connection with the perineal operation to which it is of much importance especially to attend, not only as respects the immediate result of the operation, but as regards the ultimate success of the procedure ; I mean the bringing down of the mucous membrane of the gut, and fixing it to the lips of the external wound. Unless this be done, the line of incision between the termination of the gut and the aperture in the integuments will degenerate into a fistulous canal ; which, like all fistulæ, will have a tendency to contract, and will be a source of endless embarrassment to the Surgeon and to the patient. If the mucous membrane can be brought down and fixed to the opening in the integument, this source of inconvenience will be removed, and the patient will be saved all that danger which results from the passage of the meconium over a surface of recently incised areolar tissue. This, however, can only be done when the intestine terminates at a short distance from the surface. If the perineal incision be two or three inches in depth, there will be little probability of the Surgeon being able to bring the intestine down to such an extent. In the case that I have related I attempted to do so, but found that the gut was too firmly fixed to be removed by any traction that it would have been safe to employ.

**Absence of Anus: Opening of Rectum into other Canals.**—The anal orifice may be absent, and the gut may open into one of the neighbouring mucous canals, as the vagina, the urethra, or the bladder. In such anomalous cases there is usually, I believe, but little to be done, except to restore the anal orifice if possible; but, if this be impracticable, to make a lumbar orifice, and then to take the chance of the other preternatural communication closing. This it will sometimes do; and cases have occurred in which, although the whole of the meconium with flatus had escaped *per urethram*, yet, on opening the rectum, the abnormal communication seemed gradually to close, the fæces being directed into their proper channel. In a case in which I was once consulted, there was imperforate anus and rectum, and the bowel protruded as a red fleshy tube, discharging meconium, and about four inches in length, from the anterior abdominal wall, just below the umbilicus, and immediately above an extroverted bladder. In such a complicated malformation, Surgery could evidently do nothing.

## STRICTURE—SIMPLE SYPHILITIC AND MALIGNANT.

**Stricture** may occur in any part of the large intestine, but with very varying degrees of frequency in different portions of that gut. Excessively rarely met with in the ascending or transverse, of unfrequent occurrence in the descending colon, it becomes more common in the sigmoid flexure, and very frequently occurs at about the junction of this portion of the colon with the rectum. In the rectum itself it is most commonly found either at the upper part, from four to six inches above the anus, or else a little above that aperture.

It is of three kinds: 1. the *simple*, dependent on simple thickening of the intestinal coats; 2. the *syphilitic*; and 3, the *malignant*, consisting of cancerous degeneration of the walls of the gut, or of malignant masses obstructing the bowel.

1. **Simple or Fibrous Stricture**, though occasionally occurring in the transverse or descending colon, is most frequently met with in the sigmoid flexure or at its junction with the rectum, or at the upper part of this gut, from four to six inches from the anus. This form of stricture of the large intestine commonly occurs in elderly people, and with special frequency in women. It is usually the result of long-continued diarrhœa or of chronic dysentery.

*Symptoms.*—The symptoms of simple stricture of the rectum consist at first of some difficulty in defecation, the patient being obliged to strain at stool. The fæces will also appear to be flattened, narrowed, or furrowed, and in many cases, more especially as the stricture advances, are passed in the form of small scybala, with occasionally a kind of spurious diarrhœa, consisting of the passage of the more fluid intestinal contents, whilst the solid matters are left behind. At the same time there is very commonly pain in defecation, and the occasional passage of some mucus or blood; and dyspeptic symptoms, with flatulent distension of the abdomen, are apt to come on. If the stricture be within four or five inches of the anus, it may be reached with the finger, and its precise situation and diameter ascertained. If above this point, it must be examined by the introduction of a well-greased bougie, attention being paid to the curve which the rectum makes from side to side, as well as from before backwards. In introducing a bougie in order to ascertain the presence of a stricture above the upper end of the rectum, but little information can be gained in many cases, as the point of the instrument is apt to hitch in folds of the mucous membrane, or opposite the promontory of the sacrum ; and thus, its onward passage being prevented, an appearance of constriction may present itself, which in reality does not exist, and unless care be taken the mucous membrane may actually be lacerated, and the instrument forced through it into the peritoneal cavity. In other cases, the bougie will appear to pass, when in reality its point, meeting with an obstruction, curves downwards into the rectum.

The *Progress* and termination of a simple stricture vary in different cases. In many cases persons will live on in very good general health through a long series of years, who present all the symptoms of this simple stricture of the rectum. In others the contraction of the stricture may go on increasing, until at last complete occlusion takes place, with retention of fæces and all the symptoms of obstructed bowels. This condition usually comes on slowly, and, after the obstruction is complete, life may continue for several weeks ; but in some instances the obstruction seems to take place rather suddenly, and with all the symptoms of acute intestinal strangulation, death occurring in a few days. Abscess occasionally forms in the neighbourhood of the stricture ; and, passing down into the pelvis, may burst either into the ischio-rectal space, or into the vagina, or may present upon the nates. The discharge of pus from this source, as well as from the mucous membrane lining the stricture, which falls into an ulcerated state, may induce extreme emaciation and hectic, to which the impairment of nutrition consequent upon the disturbance of digestion adds materially.

*Treatment.*—The bowels should be kept moderately open, but purgation carefully avoided, as it is a source of much irritation. Castor-oil, Carlsbad salts, or saline aperient mineral waters in small doses suit best. The diet should be carefully regulated, and the strength kept up.

The *surgical* treatment of simple stricture of the rectum must be conducted on the principle of dilating the canal at its constricted point. If this be within reach of the finger, the dilatation can be readily carried out. If it be above the upper part of the rectum, and the stricture be tight, it is extremely difficult to introduce the proper instruments with certainty. When the stricture is low down, so that the end of the finger can be introduced into it, it may readily be dilated by introducing a rectum bougie every second day, and gradually increasing the size of the instrument. If the stricture yield but slowly, and be very tight and indurated, I have found it a convenient plan to introduce a sheathed probe-pointed bistoury into it and to notch it towards its posterior aspect, where this may be done without danger to the peritoneum. A tent of compressed sponge should then be introduced, and left in for twelve hours. On its withdrawal, bougies may more readily be passed ; or the dilatation may be carried on by means of tents of compressed sponge. When the stricture is above the reach of the finger, a good deal of management will be required to make the bougie enter it. This is best done by laying the patient on his left side, and using a moderate-sized wax or elastic bougie, which must be passed without the employment of any force. When once the Surgeon has introduced one, others can readily be made to follow in the same track. The great danger in introducing a bougie high up, is to mistake the obstruction offered by its point coming into contact with one of the valvular folds of mucous membrane that occur in this situation, for that of the stricture, and, by pushing on the instrument, to perforate the bowel—an accident that would probably occasion fatal peritonitis. During the introduction of bougies, the bowels must be kept regular by means of lenitive electuary, and the occasional use of emollient enemata. If much pain or irritation should be occasioned by their presence, opium should be administered internally or in the form of suppositories. Though a simple stricture of the rectum may be much relieved by the use of bougies, it is seldom, I think, cured by this means; there being a great tendency in it to contract so soon as the treatment is discontinued.

Dilatation may sometimes be very conveniently effected by the use of Todd's dilator (Fig. 694). This is introduced closed, covered with a thin vulcanised India-rubber sheath, so as to avoid nipping the mucous membrane. It is then expanded to the required extent by pressing on a trigger in the handle.

If complete obstruction occur, an endeavour should be made to relieve the patient by the use of enemata of gruel and linseed-oil, and the strength should be supported by a diet that is nourishing, at the same time that it leaves little or no solid residue; the bowels may eventually act after a considerable lapse of time, the stricture apparently giving way. In a case to which reference has already been made, the stricture gave way after obstruction had lasted for about five weeks, some hardened fæces with bloody mucus being discharged, which were speedily followed by abundant feculent motions. Should the obstruction, however, continue, and the patient consequently be in imminent danger of death from this cause, the intestine should be opened, if possible, by Amussat's operation, performed in the way already described (p. 692, vol. II.) This may require to be done either on the right or the left side, according to the seat of stricture. In the majority of instances, this will be situated below the descending colon, so that relief may be given by opening this intestine in the left loin; but if it be impossible or even very difficult to determine the precise seat of the obstruction, the operation may as readily be performed in the right lumbar region. In those rare cases in which the stricture is seated in the transverse colon, there would probably be considerable distension of the right loin, without any corresponding enlargement of the left; in these circumstances, the proper plan would be to open the cæcum.

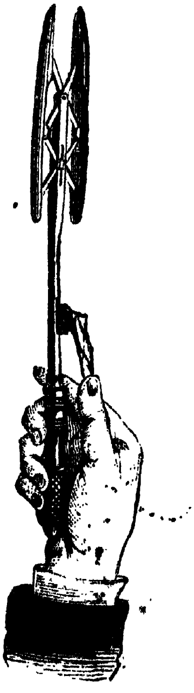


Fig. 694.—Rectum Dilator.

2. **Syphilitic Stricture of the Large Intestine** is met with in the rectum from one to three inches above the anal aperture, and chiefly in young women under thirty, rarely in men. They are essentially Hospital cases, seldom if ever seen in private practice. This form of stricture is usually situated an inch or two up the rectum. It feels as if there were a

thickened cicatricial annular constriction of the mucous membrane. At times there are ulcerations and fissures in and below this constriction, and very commonly the usual evidences of constitutional syphilis. I have seen these syphilitic ulcerations extend into the vagina, so as to establish a recto-vaginal fistula. In cases of this truly disgusting disease, the general health is usually good, and the local symptoms of rectal stricture by no means severe.

The *Treatment* consists in the usual means for the cure of constitutional syphilis, local dilatation, with or without notching, and the application of nitrate of silver to the concomitant sores.

3. **Cancer and Malignant Stricture.**—Cancer of the rectum usually occurs in the form of infiltration of the substance of the wall of the gut, giving rise to considerable induration and contraction of the bowel. In other cases, a flat cauliflower growth springs from the inner surface of the intestine, being hard, nodulated, and presenting all the ordinary characters of scirrhus; sometimes it is pedunculated, so as to resemble a hæmorrhoidal protrusion. Lastly, a scirrhous tumour may form in the areolar tissue external to the rectum, and at last press upon and implicate the gut.

*Encephaloid* is rarely met with in this region, but has been seen as a large, soft, rapidly growing fungating mass.

*Epithelioma* is rare, and when it occurs is met with at the anal orifice, often as a somewhat notched and protuberant growth. It will be found to extend into the interior of the gut, where it is more or less ulcerated.

*Adenoid Cancer or Columnar Epithelioma* of the rectum or sigmoid flexure is far from uncommon.

*Fibro-plastic* tumours will also sometimes develop in the rectum, and run a truly malignant course, with ulceration, sloughing, and rapid implication of adjacent parts.

Most usually cancerous disease is seated from three to five inches above the anus, and may implicate a considerable portion of the bowel, extending upwards rather than downwards, giving rise to considerable induration and contraction, and attended, at least in some cases, by complete occlusion of the interior of the gut.

*Symptoms.*—Cancer of the rectum is chiefly met with in middle life, but sometimes does not occur until advanced age. Both sexes are equally liable to it; if anything, it is more frequent in women than in men.

It is very insidious in most cases in its early manifestations. A sense of uneasiness, a tendency to diarrhœa, a slight discharge of blood or mucus, a feeling as if the patient had piles, are usually the only early evidences of the development of this distressing disease. After a time, the rectal pain becomes very severe. There is now a constant feeling of pain and weight in the gut, with a sensation as if the bowels had not been completely relieved, together with the discharge of mucus, blood, or pus, and some flattening of the fæces. On exploring the parts with the finger, the lower portion of the rectum will usually be found considerably expanded, whilst the tip of the finger will come into contact with the contracted, hardened, ulcerated, and rugged mass; at one part of which an opening will be found leading into a rugged, irregular, scirrhous cavity that passes up through the cancerous mass to the healthy gut above. The patient experiences most intense suffering during defecation, in consequence of the passage of fæces over the raw and ulcerated surface. This pain is not confined merely to the diseased part, where the sensation is of a hot and burning character, but usually radiates round the loins and down the thighs, and is so severe that the patient looks forward to each action of the bowels with the greatest dread, and restrains it as long as possible. The whole nervous system at last participates in this continually recurring suffering; the countenance becomes anxious; the spirits are depressed; sleep and digestion are destroyed. The patient's condition is indeed truly miserable, between the dread of excessive suffering when the bowels act, on the one hand, and the fear of impending obstruction on the other. In many instances he is worn out by this suffering, together with the constitutional cachexy induced by the contamination of the system with the cancerous matter. Not unfrequently the misery is much increased by the formation of fistulous openings in the neighbourhood of the bowel, and communications between it and neighbouring parts, such as the vagina, bladder, or urethra, with cancerous implication of them. Flatus as well as fæces thus get entrance into the bladder and vagina; the flatus passing out with a rush, the fæces sometimes obstructing the urethra, and often very seriously irritating the bladder, producing strangury and great pain.

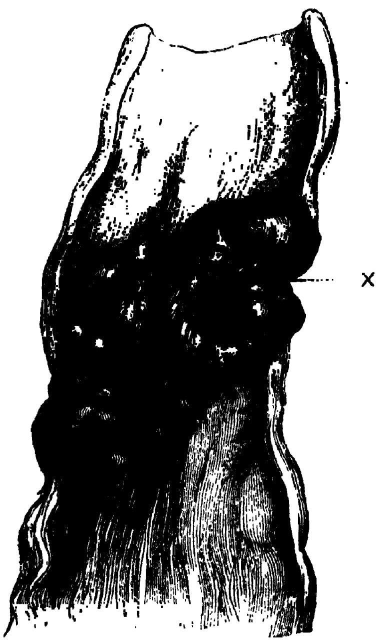


Fig. 695.—Cancer of Upper Part of Rectum. At × perforation took place, leading to fatal Peritonitis during administration of an Enema.

Death may put an end to the patient's sufferings in several ways: by exhaustion from pain and continuous discharge, together with constitutional cachexy; by perforation of the cancerous mass, which, ulcerating through at some point, opens into the peritoneal cavity, and, by hæmorrhage internal or into the gut, inducing fatal collapse, rapidly destroys life; and in other instances, though more rarely, by fæcal obstruction, as in the case of simple stricture. The reason why intestinal obstruction is comparatively rare in cancer of the rectum is, that the diseased mass ulcerates and necroses more rapidly than it grows into the bowel, and thus an irregular chasm is left in its centre, through which the fæces pass.

*Treatment.*—This must necessarily be palliative. The bowels must be relieved by occasional doses of castor-oil or by emollient enemata. Large doses of opium, or of morphia injected hypodermically, are required after each action of the bowels to lessen the patient's distress. Little good can be expected from more active measures ; dilatation only irritates the disease and would tend to increase the mischief. The application of caustics, such as potassa fusa, offers no prospect of advantage, as only a superficial slough could in this way be formed without very serious risk of perforation ; it is, besides, an excessively painful remedy. Amussat has proposed to crush and break down the morbid mass by means of the finger and forceps ; but from such treatment as this little good can be anticipated. The recommendation to excise the cancerous mass, as made by Lisfranc and other French Surgeons, is contrary to every principle of good surgery ; as it is impossible to extirpate the whole of the disease, without either laying open the peritoneal cavity, or destroying the patient by the profuse hæmorrhage, which could scarcely be arrested. If palliative means fail in affording the requisite relief, and the patient suffer much local pain and constitutional irritation during defecation, the propriety of establishing an artificial anus in the left lumbar region by colotomy may be discussed ; not with a view of saving life, but rather in the hope of prolonging existence, and lessening suffering by preventing the exhaustion and agonising pain that attend the passage of the feculent matter over the ulcerated surface (p. 692, vol. II.).

*Colotomy* may be required in cancer of the rectum for one of three reasons : 1. To relieve the intense agony resulting from the passage of fæces over the ulcerated cancerous masses ; 2. To relieve the suffering and great discomfort occasioned by the fæces passing into the bladder or vagina ; 3. For the relief of more or less complete obstruction giving rise to stercoraceous distension of the abdomen. In any case it is only a palliative ; but by its means life may be prolonged as well as rendered more endurable.

**Cancer of the Anus.**—This is not a very common affection ; it usually occurs secondarily in consequence of scirrhus of the rectum spreading to and involving the margin of the anus. When it occurs as a primary disease, it is usually in the form of epithelioma, and may then form about the anus, just as it does at other muco-cutaneous apertures. If limited, and detected in the early stage, it may advantageously be excised ; but at a more advanced period of the disease, such a practice can scarcely be adopted with any prospect of success, in consequence of the impossibility of removing the whole of the structures implicated.

**Fibro-Plastic Tumour of the Rectum** is occasionally met with, forming large and somewhat pale tuberose masses, projecting into the interior of the gut, or even protruding through the anus, and giving rise to the same train of local symptoms as characterise cancer of the gut—although the pain is less intense. In such cases as these the disease may, if limited or pedunculated, be removed by double whipcord ligature or by the écraseur. By means of this instrument, I have removed from the inside of the gut a tumour of this kind nearly as large as the fist. Recurrence may of course be expected, but the patient will get relief for a time.

*Papilliform* tumours are also met with in this region, causing much obstruction, irritation, and hæmorrhage. They may be removed in some cases by dividing the sphincter, dilating the gut, and then extracting or destroying the mass.

**Polypi** sometimes form in the rectum, constituting large pendulous tumours of a fibro-mucous character (Figs. 696, 697). They often give rise to profuse and repeated hæmorrhages. They may safely be removed by the application of a ligature to their neck.

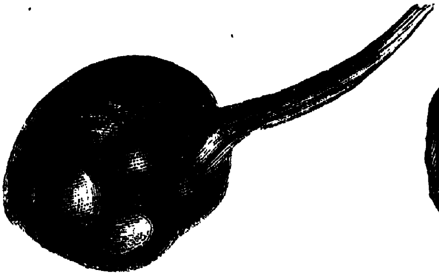


Fig. 696.—Polypus of the Rectum with Pedicle, removed from child 7 years old.

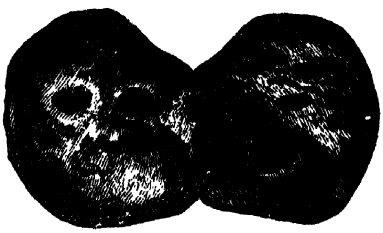


Fig. 697.—Polypus of the Rectum cut open, showing cysts lined by Columnar Epithelium.

## RECTAL FISTULÆ.

**Fistulous openings** occasionally occur between the rectum and the bladder in men; or between this gut and the vagina in women.

**Recto-Vesical Fistulæ** are not of common occurrence, and usually result either from organic disease of a cancerous character, establishing a communication between the rectum and the bladder; or from a wound of the gut during the operation of lithotomy. In these cases the urine escapes *per anum* in greater or less quantity, occasioning constant irritation or excoriation, with a sort of liquid diarrhœa; and the wet state in which the patient is kept by the dribbling of urine gives rise to an offensive ammoniacal odour about him. If the communication between the rectum and bladder be a free one, feculent matter and flatus get admission into the urinary organ, and escape from time to time by the urethra; perhaps even more abundantly than the urine does *per anum*. This is especially the case when the fistula is carcinomatous; and it is remarkable how little irritation is often set up by this admixture of fæces with urine in the bladder. The fistulous aperture in the rectum can always readily be detected by passing the finger into the gut, or examining its interior with the speculum ani.

*Treatment.*—If the disease be cancerous, nothing can be done in the way of treatment beyond keeping the parts clean; but if it be traumatic in its origin, of small size, and more especially if it be recent, its closure may not unfrequently be accomplished by touching it with the nitrate of silver, or a red-hot wire through a speculum ani. In these cases the galvanic cautery might advantageously be employed. If, however, the fistula be of old standing, and the aperture large, cauterisation will probably not succeed; and then perhaps the only mode of treatment that can be adopted will be to introduce a grooved staff into the urethra, and cut through the sphincter upon this, thus laying the parts into one, and converting the anal into a perineal fistula. By keeping the catheter in the bladder, and emptying this, granulations will be allowed to spring up, and deep union be accomplished. In cancerous recto-vesical fistula, colotomy may be had recourse to with every prospect of mitigating the patient's sufferings (Vol. II. p. 708), and of thus prolonging life.

**Entero-Vaginal Fistula.**—It has happened that a communication has been set up between the small intestine and the vagina, an artificial anus in fact forming in this cavity. These cases, however, are very rare, and may indeed be looked upon as incurable. Roux and Casamayor have endeavoured to establish, by a deep and difficult dissection, a communication between the small and large intestine ; but the operation, as might have been expected, has proved fatal.

**Recto-Vaginal Fistulæ**, may arise from two causes ; 1st, sloughing of the posterior wall of the vagina, in consequence of some undue pressure exercised upon it during parturition ; and 2nd, its perforation by syphilitic ulceration. They are of two kinds ; viz., the simple, consisting of a button-hole opening (and these are often syphilitic), and those complicated with more or less extensive laceration of the perinæum. The size of these fistulous openings, when uncomplicated with rupture of the perinæum, varies greatly ; in some cases there is merely a small perforation, in others there may be loss of the greater portion of the posterior wall of the vagina. Whatever their size, they are necessarily sources of very great discomfort and annoyance, both physical and mental, to the patient. The recognition of the disease is of course at once made ; the escape of the fæces and flatus into the vagina being obvious, and digital or ocular examination through the two-bladed speculum at once detecting the seat and extent of the aperture. As there is just the possibility of the communication existing between the vagina and the small intestine, it may be useful to bear in mind that, in this case, the feculent matter that escapes has been found to be yellower and less stercoraceous than when the rectum is opened.

The *Treatment* will vary according as the fistula is simple, or complicated with lacerated perinæum.

*Simple uncomplicated Recto-Vaginal Fistula*, if it be small and recent, may occasionally be closed by attention to cleanliness, at the same time that its edges are touched with the nitrate of silver, a hot iron wire, or the platinum loop. If it be very large, the greater part of the posterior wall of the vagina having been destroyed, it will probably be incurable ; but even here the patient should not be left to her fate, and some operation should be attempted which may lessen its size, even if it do not completely close it. The kind of fistula which is here most commonly met with usually consists of a circular aperture, that readily admits the point of the finger, as it is situated just above the sphincter ani. The operation for the closure of a recto-vaginal fistula of this kind consists, after emptying the patient's bowels by purgatives and an enema, and the bladder by the catheter, in introducing a duck-billed speculum into the vagina, and freely paring the edges of the aperture. As the fistula is always low down, this is readily done by placing the patient on her back, and tying the hands and feet together, as in lithotomy. The vaginal mucous membrane should be dissected off towards the fistula. The next point is to bring its edges into apposition, in a direction transverse to the axis of the vagina ; and in doing this, the recommendation made by Copeland and Brown, of dividing the sphincter ani, should always be acted on, as it is a most important auxiliary to the success of the operative procedures that are required ; for, as there is always loss of substance in these fistulæ, there is necessarily a tendency to tension on their sides when any attempt is made to draw them together ; and it is also of importance that any muscular movement about the parts in the neighbourhood of the fistulæ should be arrested, as this might otherwise break down union after it had taken place between the edges. The sides of the fistula must then be drawn into apposition by silver sutures introduced by means of the hollow needle. I have generally found that these sutures are most easily introduced if passed *from above downwards*—the mucous membrane being then drawn upon by the needle, which more readily transfixes it than if it be introduced from below upwards, when it is left to push the membrane before it. The wires are then passed across the fistula and out through the vaginal mucous membrane, half an inch beyond the freshened surfaces, care being taken not to include the rectal mucous membrane. They may then be twisted, or brought through a leaden plate and clamped by shot. The success of the procedure depends not only on the proper completion of the steps of the operation, but greatly on the after-treatment. This should consist in the administration of opium, to prevent the bowels from acting for ten or twelve days ; indeed, until firm union has taken place between the edges. They may then be moved by means of laxatives and oleaginous enemata carefully given. During the treatment, the parts should be disturbed as little as possible, the patient lying on her side with a gum catheter tied in the bladder. The parts should be well syringed twice a day with cold water. The patient must be kept upon a very moderate diet, and the stitches may be left in for eight days, when they must be cut out and carefully removed. Should any point of the fistula not be closed, the application of the nitrate of silver may induce proper union of it.

If, as very commonly happens, the *Recto-Vaginal Fistula be complicated with a Lacerated Perinæum*, the operation for that condition, described at p. 655, vol. I., must be performed, and the edges of the fistula, being deeply pared, brought together at the same time. Sometimes in these cases it happens that the perinæum unites, leaving an aperture above this in the recto-vaginal septum ; if this aperture be but small, it may be closed by its edges being touched from time to time with the actual cautery ; if it be large, so as to allow the introduction of the finger, I believe that it is generally useless to attempt to close this aperture by itself ; but the perinæum should again be divided, and the whole operation repeated.

## ULCER AND FISSURE OF THE ANUS.

This disease, though trivial in point of size and in its pathological relations, is of great practical importance, on account of the excessive local pain and great constitutional irritation to which a patient labouring under it is often subject. Ulcer and fissure commonly exist together in this situation, though it by no means unfrequently happens that the two conditions occur separately.

The ulcer is usually of small size, seldom larger than a silver three-pence, of a circular or longitudinal shape, situated between the folds of the mucous membrane in the upper part of the anus, or rather the lower part of the rectum, just above the ring or ledge formed by the sphincter, and is usually met with towards the posterior part of the gut on one side of, or opposite to, the point of the coccyx. Occasionally more than one ulcer exists in this situation. If a fissure accompany the ulcer, it commonly leads from this across the face of the sphincter to the verge of the anus; but in many cases one or two fissures, sometimes even three or four, exist without any ulcer. The fissures are usually slightly indurated and cord-like, extending merely through the mucous membrane, scarcely, if at all, implicating the deeper structures; and not unfrequently their external termination is concealed by a small red pile or flap of integument.

The existence of the ulcer may usually be determined by exploring the rectum with the finger, which, if practised in these examinations, will detect a small, soft, and velvety patch at the diseased spot; on touching this, the patient will usually complain of acute and burning pain. In some cases the ulcer may be brought into view by examining the rectum with the speculum ani, here delineated (Figs. 698 and 699). The fissure may always readily be detected by everting the mucous membrane of the anus, and by lifting up or turning aside the pile that covers the lower end of the crack. During this examination, it will usually be found that the sphincter ani is in a more or less spasmodically contracted state, admitting the finger and instrument with difficulty.

*Symptoms.*—The symptoms of ulcer or fissure in the anus are very characteristic. The patient complains of pain, usually of a severe burning character, on the passage of a motion, especially if a hard one; occasionally it occurs at the time of defecation, but more frequently commences a few minutes afterwards, and continues from half-an-hour to several hours. This pain is very severe, and peculiarly wearing and burning; it is generally most felt opposite the sacro-iliac articulation, but not unfrequently radiates round the pelvis or down the thighs. In many cases it produces a good deal of continued irritation about the genito-urinary organs, giving rise to symptoms of spasmodic stricture;

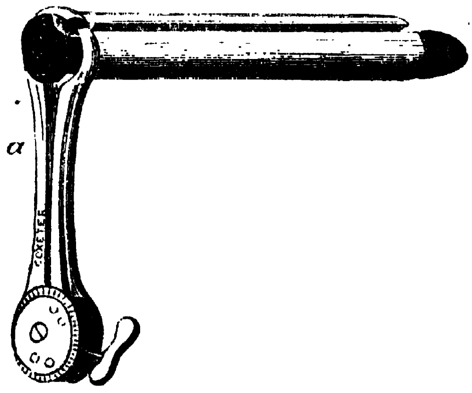


Fig. 698.—Anal Dilator.

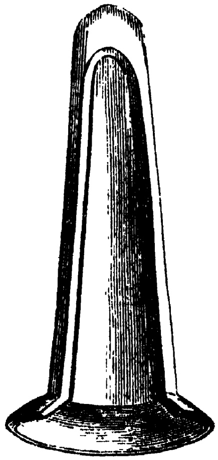


Fig. 699.—Speculum Ani.

a frequent desire to urinate, tenderness about the prostate, and seminal emissions. The pain is sometimes so severe that the patient avoids defecation as long as possible, and even abstains from food with the view of lessening the necessity for the frequency of this act. Very commonly in women, the pains produced by the rectal disease simulate those occasioned by uterine irritation ; and in both sexes they may after a time become continuous, and be attended by a good deal of constant uneasiness in sitting, so that the patient is obliged to raise the hip of the affected side. There is often a discharge of a streak of pus or blood on the fæces, and commonly a good deal of mucous exudation, with some tenesmus on defecation ; but in some instances these symptoms are altogether absent, and the patient never suffers any local inconvenience except from the pain.

The constitutional irritation is often very great, the nervous system generally sympathising with the local mischief. The countenance becomes pale, anxious, careworn, and the patient's expression is indicative of constant suffering.

*Causes.*—This affection most commonly occurs in women, especially in those of an hysterical temperament and weakly constitution. When met with in men, it is most frequently seen in enfeebled, cachectic, and debilitated subjects, and appears to be the result of a broken state of health. In persons who have been the subjects of the chronic dysentery of hot climates, I have several times noticed a peculiar form of patchy ulceration within the rectum, of an extremely irritable and very intractable character. I have in several instances observed it in women to be of a syphilitic nature, and in such cases it is situated generally towards the side or the anterior part of the anus.

The rectum may be injured by blows or falls upon the sacrum or coccyx. Fissure, laceration of the mucous membrane, rupture of the muscular fibres, or even the detachment of the whole of the rectum from its connections with the sacrum and coccyx, may ensue from these injuries.

*Treatment.*—The treatment of fissure or ulcer of the anus, when the disease is met with in the early stages, may sometimes be successfully conducted by the application of nitrate of silver to the fissure, and the use of an anodyne or astringent suppository. I have found a very excellent and useful suppository in this and many other painful affections of the anus to be composed of 2 grains of extract of belladonna, 2 grains of the acetate of lead, and 4 of tannin, made up to a proper consistence with a little cocoa-butter. This may be introduced into the rectum every night and allowed to dissolve there ; the bowels should at the same time be kept gently open with castor-oil, or the lenitive electuary. In those cases in which the disease has been of some standing these means will not suffice, and it becomes necessary to have recourse to a very simple operation to effect a cure. This consists in dividing the affected mucous membrane through the ulcer or fissure, with possibly some of the subjacent fibres of the sphincter muscle, by which the part is set at rest, and cicatrisation speedily takes place. The relief after the operation is usually immediate ; indeed, after its performance, a patient who has been suffering severely for months or years, will often get complete and almost instantaneous relief. The merit of introducing this plan of treatment for the cure of ulcer and fissure of the anus into surgical practice is due to Sir B. Brodie. Boyer had previously recommended that the sphincter should be cut completely across, in order that its action might be paralysed; but Brodie found that the ulcer could be made to heal as readily by the limited incision above mentioned. The operation is readily done by introducing the left fore-finger into the rectum, guiding along it a probe-pointed bistoury, and then cutting downwards and outwards, carrying the knife about the eighth of an inch in depth. No dressing is required after this operation; but, if the incision do not readily heal, it should be touched from the bottom with the nitrate of silver. The patient's bowels should be well opened before the operation, and a dose of castor-oil may be given on the second or third day after it. During the process of cicatrisation it will often be advantageous to give iron, and to put the patient on a nourishing diet.

**Spasmodic Contraction of the Sphincter Ani** is usually associated with fissure or ulcer of the anus, or inflammatory irritation of some neighbouring organ; but occasionally it occurs without this complication, and in all cases it may be connected with a neuralgic condition of the part. In hysterical women, this neuralgia and spasm are especially apt to occur; though it is not improbable that, in many of the so-called cases of neuralgia of the anus, some positive disease, such as a small ulcer or fissure, may be detected on close examination, as I have had several occasions to verify.

The *Treatment* of contraction of the sphincter, whether associated with neuralgia or not, consists in the employment of local sedatives, especially the extract of belladonna, gr. j. to gr. ij., as a suppository; the bowels being kept relieved by enemata and confection of senna. Should these means fail, the patient must be anæsthetised, and the sphincter forcibly dilated with the Surgeon's fingers.

**Atony of the Rectum** is common in middle age, in those who lead sedentary lives, and especially in women. This condition is the consequence of and leads to habitual constipation, the walls of the rectum becoming expanded and pouch-like. It may occasion the retention and impaction of hardened fæces. A mass of clayey consistence, and as large as the fœtal head, forming in the rectum and interfering seriously with defecation, becomes a source not only of great discomfort but of serious ill health. Like all retained excreta, it slowly poisons the system, giving rise to foul breath, dirty greyish complexion, and mental depression.

The *Treatment* of atony of the rectum consists in scrupulous care in emptying the bowels by the administration of cold enemata. If impaction of fæces have occurred, this is to be remedied only by putting the patient under chloroform, forcibly dilating the sphincter with the hand, and breaking down the hardened mass with a lithotomy scoop or iron spoon, washing it away with enemata; and thus clearing out the bowel. (See p. 670.)

## ABSCESS AND FISTULA.

Abscess not unfrequently occurs in the vicinity of the rectum and anus. It may either be superficial, being confined to the muco-cutaneous structures, and presenting the ordinary characters of acute subcutaneous abscess; or it may be deeply seated, forming in the ischio-rectal fossa. It is these rectal abscesses that are of most practical importance. They may be of two kinds—**Acute** and **Chronic.**

**Acute Ischio-rectal Abscess.**—This forms deeply in the fossa, with throbbing, shooting, and stabbing pains through the anus, rectum, and perinæum ; on examination, a hard brawny substance may be felt in the areolar tissue by the side of the gut, either by examination from without, or by exploration through the rectum. It speedily softens, and will, unless an outlet be made for it, either burst externally, or into the cavity of the gut, or both ways. This acute form of abscess usually occurs in persons of otherwise strong and healthy constitutions.

**Chronic Ischio-rectal Abscess,** on the other hand, occurs insidiously in persons of cachectic, broken, or phthisical constitutions. Without much pain or local inconvenience, it forms a collection of pus, which is usually limited to one side of the ischio-rectal fossa, but in other cases acquires considerable magnitude, denuding the gut to a considerable extent ; in fact, almost surrounding the rectum, and then spreading widely on the nates or hip, presenting all the ordinary characters of a chronic abscess. This kind of purulent collection may form in this as in any other situation in the body, as the result of congestion or of some local irritation. I have several times seen it follow kicks, blows, or bruises of the lower part of the body, or as a consequence of the lowering of the vitality of the mass of areolo-adipose tissue on the ischio-rectal fossa by weakly persons sitting on a cold stone, or standing for a long time on the ice or snow. In other cases the mischief appears to originate around the prostate, and an abscess forming in this situation may find its way down by the side of the rectum. Sir B. Brodie attributed these abscesses, and the consequent fistulæ, to perforations of the mucous membrane of the gut ; and although I think he exaggerated the frequency of this mode of production of the abscess, yet there can be no doubt that, in some instances at least, it occurs as the result of perforation of the bowel ; either by ulceration from within, by the formation of a fissure, or by some foreign body, as a fish-bone, transfixing it, and thus inducing inflammatory action in the areolar tissue outside the rectum.

*Treatment.*—In the treatment of these abscesses, the principal point to be attended to is to prevent the extensive denudation of the gut. In order to do this the abscess must be opened, so soon as the formation of pus can be ascertained to have taken place, by making a free, and, if necessary, a deep incision into the ischio-rectal space by the side of the bowel. Unless this be done, it may either burst into the interior of the gut, or spread widely upon the nates, and then give way. The pus that is let out of these collections is always extremely offensive, even though not mixed with any feculent matter ; the near neighbourhood of the bowel appearing to determine some change in it that renders its smell peculiarly stercoraceous. After the evacuation of the abscess the patient feels easy, and thinks that all is well, the discharge gradually lessening and the cavity contracting ; but it does not close, and a fistula will be left, which continues to exude a thin watery pus, in which feculent matter, perhaps, accumulates from time to time, giving rise to fresh outbreaks and extensions of the disease.

FISTULA IN ANO.—The sinus left by the contraction of the cavity of an ischio-rectal abscess constitutes a *fistula in ano*; an affection that has attracted a good deal of attention from the frequency of its occurrence, and from the difficulty of curing it without having recourse to operation.

*Extent.*—Sometimes a fistula is very limited, being merely the sinus left in the submucous areolar tissue of the anus after the bursting of a superficial abscess in this situation, extending to a short distance up the gut inside the sphincter. This form of fitsula constitutes, however, a kind of spurious variety of the disease; for the true fistula in ano is outside the sphincter in the surrounding areolar tissue, extending always as high as the upper margin of that muscle, and frequently stretching to a considerable distance up the side of the gut. Most frequently the lower and external aperture of the fistula is single, and is situated by the side of the anus in the ischio-rectal fossa, just beyond the sphincter; but not unfrequently the aperture is in the perinæum, or posteriorly in the coccygeal region. Occasionally there is a fistulous opening on each side of the gut; or several openings may exist, and then sinuses extend from these upwards and outwards to a considerable distance, undermining the integuments of the perinæum about the buttocks, even stretching away towards the trochanters, and opening at a great distance from the bowel. These extensive fistulæ and sinuses are frequently connected with stricture of the gut; but they may occur without this in old and neglected cases of the simple disease.

The fistulæ are usually oblique, but straight in their direction from a point half an inch or an inch from the anal aperture, running upwards to above the sphincter. In some cases they are tortuous; and, occasionally, when opening at a distance from the gut, and extensively undermining the integuments, they are angular, having, as it were, an elbow at that point where the superficial sinus meets the deep fistula. This peculiarity will prevent the passage of a probe through their whole length until the external sinus has been slit up, and the commencement of the deep fissure reached, and may lead to the supposition of the fistula being more superficial than it in reality is.

*Varieties.*—Fistula in ano is said to be **Complete** when it communicates by one end with the interior of the rectum, and opens by the other upon the external surface. It is said to be **Incomplete** when it has only one aperture, whether that be external or internal.

**Complete Fistula** is the most common form. It probably arises in the majority of cases from some source of irritation seated within the bowel, by which the mucous membrane of the rectum has been perforated, and an abscess has formed in the areolar tissue outside the gut. The external opening in this form of fistula is usually from half an inch to an inch from the margin of the anus; though it may be seated at a greater distance than this, as upon the hip. It is commonly small, and has a vascular granulation projecting from or occluding it; and a thin purulent discharge usually drains away from it in small quantities, moistening the surrounding integuments. The internal opening is usually situated just above the sphincter, where the rectum begins to expand. But the fistula does not terminate at this internal aperture; for in the majority of cases it runs up into a kind of *cul-de-sac*, to a considerable distance further. The internal aperture may readily be detected by introducing a blunt curved probe into the fistula; when, by a little management, it may be carried through the inner opening. In some cases, the existence of this may be ascertained by examining the interior of the bowel with a speculum ani, and by injecting water into the external opening.

**Incomplete** or **Blind Fistula** may be of two kinds, and commonly arises from constitutional causes. When there is no internal perforation, a mere sinus having been left by the bursting of an abscess, the fistula is termed *blind external.* When there is only an internal aperture, it is called *blind internal.* The blind external fistula is readily recognised by its being found that the probe does not penetrate the interior of the gut. The blind internal is not so readily detected ; but in this case it will generally be found that the patient suffers from an occasional and tolerably abundant discharge of pus from the interior of the bowel ; that there is a good deal of tenderness, with some brawny induration in the ischio-rectal fossa on one side of the anus ; and that the pus may be made to well out in some quantity by pressing upon this part. On passing the finger into the rectum, the ragged internal aperture in the gut through which the pus exudes may readily be felt.

*Treatment.*—Operative interference is usually necessary. It is true that in some rare instances the fistula may be made to close under the influence of constitutional management, aided, perhaps, by stimulating its interior with the nitrate of silver, or by touching it with a probe dipped in nitric acid. This kind of treatment is, however, only successful in the blind external fistula, several instances of which I have seen recover in this way ; but it can never be expected to answer in any other variety of the disease. Occasionally in elderly people a blind internal fistula (or fistulæ) will be found, which, falling into a very chronic state and discharging but little, is a source of but very trivial discomfort, and will continue for years without giving the patient serious local inconvenience, and in no way disturbing the general health. In such cases, I believe, there is often far less risk in leaving the fistula untouched, than in subjecting the patient at an advanced period of life to the hazards of an operation. When the fistula is complete, the only plan of treatment that offers any chance of success is the division of the sphincter ; so that this muscle, which tends to prevent the closure of the sinus, may be paralysed, and the fistula, being laid open from the bottom, made to heal by granulation. Various plans have been devised for the division of the sphincter, and much ingenuity has been expended in attempts to discover simpler and less painful modes of effecting this than by the knife, but hitherto without success ; and the only plan of treatment that deserves any attention is the division of the sphincter with a curved bistoury.

The **Operation for fistula in ano** should not be performed indiscriminately in all cases and at all periods of the disease. If the fistula be dependent upon stricture of the gut, and more especially if this be of a malignant character, it is evident that no operation can be attended by a chance of success, and none should be attempted. So, also, if the patient be cachectic and broken in health, it is well to improve his constitutional powers before undertaking an operation, lest the wound that results may not readily cicatrise. It is also well to wait until the disease has assumed a somewhat chronic form before proceeding to the division of the sphincter ; if this be done early after the bursting of the abscess, or at any time if there be much inflammatory action going on, the wound is apt to assume a somewhat sloughy condition, and to heal with great difficulty. The most important question usually connected with the operation for fistula, is the propriety of performing it in phthisical subjects. It is a well-known fact that fistula in ano is especially apt to occur in consumptive individuals, and it is often a nice point to determine whether an operation should be performed or not in them ; how far the drain from the fistula may keep up or even generate the tendency to phthisis, or how far it may be salutary in acting as a counter-irritant, and in preventing the morbid condition of the lung from developing itself. Theophilus Thompson has stated that the co-existence of fistula with phthisis appears to retard the progress of the latter disease, acting as a derivative ; and doubtless in some instances this may be so. I have, however, in several cases found considerable advantage result from operating for fistula in the early stages of phthisis, or in suspected cases of that disease, the patient's health having considerably improved after the healing of the fistula. In such cases it may be of use to put an issue in the arm or side of the chest. But in confirmed, and still less in advanced phthisis, no operation should ever be practised ; as the wound will not heal, and the patient must be weakened by the additional discharge.

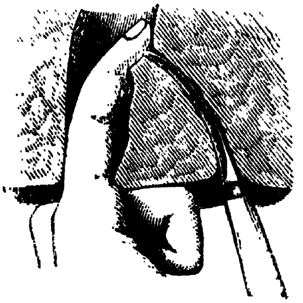


Fig. 701.—Operation for Fistula in Ano.

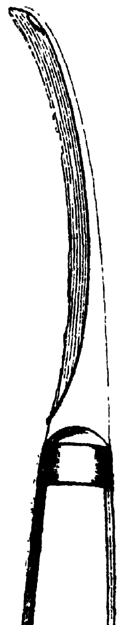


Fig. 700.—Probe-pointed Bistoury for Fistula.

The operation for *complete* fistula should be performed in the following way. The bowels having been well cleared out the day before with a dose of castor-oil, and an enema administered on the morning of the operation, the patient should be laid on his left side, with the nates projecting over the edge of the bed ; a probe must then be passed through the fistulous track into the rectum, and the Surgeon, introducing the forefinger into the gut, feels for the end of the instrument ; he then passes a short strong-bladed probe-pointed bistoury of about the size and shape of that represented in the annexed figure (700) through the fistula, using the probe as a guide, though in some cases this may conveniently be dispensed with. When he feels the end of the knife projecting into the rectum through the internal aperture of the fistula, he, after withdrawing the probe, hooks his forefinger over it (Fig. 701), and by a sweeping and pressing cut, raising the handle of the instrument at the same time that he pushes down its point, brings both finger and blade out at the anal aperture, cutting through the whole thickness of the parts between this and the fistula, so as to lay the two cavities into one. Care should be taken to divide the sphincter in a direct and not an oblique manner, lest a flap or fold be left which will interfere with the proper healing of the wound. In performing this operation, the Surgeon should cut with his left hand if the fistula be upon the left side ; and in either case should be careful not to wound his own finger, as such cuts often prove troublesome in healing. Where the external aperture or apertures of the fistula are at some distance from the gut, the integuments being undermined to a considerable extent, perhaps thinned, soft, and bluish, all the superficial sinuses should be slit up; and, in those cases in which the course of the fistula runs more or less at a right angle with that of the external sinus, it is necessary to do so before the deep or internal fistula can be reached, through which the sphincter must be divided. If the fistula be a *blind external* one, it must at the time of the operation be made complete, by scratching with the end of the knife through the thinned structures that intervene between its extremity and the interior of the gut; and the operation must then be completed in the way described. If it be a *blind internal* fistula, a bent probe should be passed up the anus and through the inner opening of the fistula into the canal. The end of this, which can be felt externally, must be exposed by a puncture made through the integuments with a sharp-pointed bistoury, and the operation then concluded in the ordinary way.

When there is an internal aperture into the gut, this will usually be found just above the sphincter; but the fistula does not terminate here, frequently extending up by the side of the gut for an inch or two. In these circumstances, what should be done with the *cul-de-sac* above the inner aperture? If it be laid open, an extensive and deep wound will be inflicted, which may implicate some of the hæmorrhoidal vessels, and thus give rise to a dangerous amount of bleeding. Hence I think it a safer practice for the Surgeon to content himself with the division of the sphincter and all the parts intervening between the inner aperture of the fistula and the verge of the anus; the sinus which is left usually contracting and closing without difficulty when this has been done. In some cases it happens, however, that this *cul-de-sac* is not readily obliterated, but gives rise to a good deal of trouble in consequence of the occasional accumulation of pus in it, and the thickening of its aperture into the bowel giving rise to spasmodic contraction of the sphincter and a kind of rectal stricture. This inconvenience gradually subsides in most cases, under the use of astringent injections or the introduction of a probe armed with nitrate of silver. If the integuments around the fistula have been much undermined and thinned so as to leave loose flaps at the edges of the incision, the cure will be materially hastened by cutting these off.

The after-treatment should be as simple as possible, consistently with securing closure of the wound by granulation from the bottom. A narrow slip of oiled lint should be introduced between the lips of the wound, and this must be left in for forty-eight hours, during which time the bowels are kept confined by the administration of a grain or two of opium immediately after the operation. On the second day a dose of castor-oil may be administered, which will not only act upon the bowels, but bring away the piece of lint. The wound must then be lightly dressed from the bottom, a poultice applied, and care taken at the daily dressing, by the introduction of a probe, to prevent the bridging over of granulations. After the wound has completely united, a notch will usually be left by the side of the anus, which gives rise to some inconvenience for a time by the occasional involuntary discharge of a little intestinal mucus, and some flatus. This especially happens in those cases in which the incision has been made anteriorly to the anus into the perinæum, and where incontinence of fæces may, for a time, be left. Should an inconvenient or dangerous amount of hæmorrhage occur at the time of the operation, the wound should be plugged with dry lint, and a firm pad applied by means of a T-bandage. Should profuse bleeding, in consequence of the division of some of the hæmorrhoidal vessels, come on a few hours after the operation, all coagula should be cleared away, the gut washed out with ice-cold water, and then securely plugged either with a piece of compressed sponge, or with a lithotomy or œsophagus tube, surrounded by lint soaked in a solution of perchloride of iron, and pushed into the bottom of the sinuses that have been laid open.

## HÆMORRHOIDS OR PILES.

By **Hæmorrhoids** or **Piles** is meant a morbid condition of the blood-vessels of the anus and lower part of the rectum, especially of the veins of the submucous or subcutaneous areolar tissue, giving rise to more or less intumescence of the part, which may or may not be attended with a discharge of blood. Surgeons are commonly in the habit of classifying piles, according as they bleed or not, into **Open** or **Blind** ; or, according as they are situated above or below the verge of the anus, into **Internal** or **External** ; the internal being always within the gut, the external habitually protruding out of or around the anal aperture. The first may either bleed or not ; the latter are always blind. To this division into external and internal, B. Cooper has added an intermediate variety, the **Intero-External**, which is partly within and partly without the anus. These divisions are of much practical moment, as the treatment is very materially modified according as the hæmorrhoid is situated above or below the anal verge.

PREDISPOSING CAUSES.—We must look to the peculiar *arrangement of the veins of the rectum* as directly predisposing to the occurrence of piles. The lower part of the rectum and the verge of the anus are composed of a plane of muscular fibre and a muco-cutaneous surface, with an intervening stratum of dense areolar tissue. In this areolar membrane is situated a close interlacement, or net-work, of tortuous veins. The blood, from this plexus of hæmorrhoidal veins, finds its way into the general system through two distinct channels. By far the greatest portion of it is carried into the inferior mesenteric vein, and thence into the vena portæ, through the medium of the superior hæmorrhoidal vein, which may be looked upon as the extreme radicle of the portal system ; and a certain quantity passes into the internal iliac vein through branches that accompany the middle and inferior hæmorrhoidal arteries. We may, therefore, look upon the hæmorrhoidal plexus as being placed midway between the portal and general venous systems, being the point indeed at which they touch ; but as belonging rather to the portal than to the systemic veins. In these arrangements we see all the elements that would predispose to congestion, and consequent dilatation of the vessels of a part. There is a large and intricate plexus of veins in which, as in all similar net-works, there is a tendency for the blood to circulate slowly at times ; the natural tendency to stasis of the blood being much increased by the dependent position of the part, and by the anatomical fact that, in consequence of the absence of valves in the superior hæmorrhoidal vein and in the vessels into which it pours its contents, the whole pressure of the column of blood in the portal system may be brought to bear upon the hæmorrhoidal plexus. The circulation through the portal system is likewise subject to much interference in consequence of hepatic and intestinal obstruction, and in these changes the blood in the hæmorrhoidal plexus also participates; and, were it not for the provision that exists by which this plexus may free itself to a certain extent from over-distension by its communication with the internal iliac through the medium of the middle hæmorrhoidal vein, piles would be much more frequent than they even now are, as a consequence of obstructed portal circulation. Another great cause of hæmorrhoidal enlargement is to be found in the want of support that the veins of this plexus experience on their mucous aspect during defecation. Situated as they are in areolar tissue, between a plane of muscular fibres on one side, and yielding mucous membrane on the other, when distended by the constriction which they undergo during and after the expulsion of the contents of the rectum, they necessarily give way on that side on which they have the least support, being forced down and elongated, together with the mucous membrane under which they ramify, and which has a natural tendency to become slightly everted during the act of defecation. It will be found that all the more immediate or exciting causes of piles act by unduly increasing one or other of those natural tendencies that exist in the system, by favouring the local congestion or determination of blood, at the same time that they produce a lax state of fibre.

*Age* exercises considerable influence in predisposing to piles. This disease is not unfrequently met with in young men of eighteen or twenty years of age; more especially if they be of a relaxed and phlegmatic temperament with languid circulation, and be obliged to lead a more sedentary life than is natural or proper at that age. After this period, the liability to the disease diminishes until middle age is reached, when the tendency to hæmorrhoidal affections is again increased, and becomes more marked than at any former period of life, owing to the more active operation of those causes that tend to impede the return of the portal blood.

*Sex* appears to exercise more influence on the occurrence of hæmorrhoids at particular periods of life, than on the general liability to the disease. It certainly appears to be more frequently met with amongst men at an early age, than in young women; but at a later period of life, so far as my observation goes, the disease occurs with nearly equal frequency in both sexes. The comparative exemption of young women is readily accounted for, by the periodic discharges from the uterus preventing the congestions that might otherwise occur in the parts in its vicinity. The greater frequency in females at a later period of life is attributable not only to the tendency induced during pregnancy by the pressure of the gravid uterus, but also, after the cessation of the menses, to the determination that is apt to be set up in certain organs of the female economy, and to the retardation of the portal circulation by the accumulation of fat and other causes; these conditions chiefly occur in women of a sanguine and plethoric habit of body.

*A sedentary life* with indolent habits constitutes, perhaps, the most powerful predisposing cause of the disease; more especially if habitual high living be conjoined with want of proper and sufficient exercise. Indeed, the artificial and luxurious habits of the more opulent classes, by diminishing tone at the same time that they occasion plethora and a tendency to abdominal engorgement, exercise a considerable influence on the occurrence of this disease, which is much more frequent amongst them than in persons in the humbler walks of life.

There are a number of minor conditions which are commonly looked upon as predisposing causes of this disease, though it is extremely difficult to determine the precise share that each has in its occurrence. Amongst these may be mentioned intemperance in food and drink; residence in warm, moist, and relaxing climates; the use of soft and warm beds, or the opposite condition of sitting on a cold stone or damp cushion. Over-excitement of the generative organs will also occasion it.

EXCITING CAUSES.—Amongst the exciting causes may be mentioned *local irritation* of any kind. Thus, in some people hard riding will bring on an attack of piles. The *habitual use of drastic purgatives,* more especially of aloes, rhubarb, &c., is well known to occasion the disease; though it must be observed that individuals, who make habitual use of these remedies, often labour under some of those obstructions of the abdominal viscera that have already been noticed as conducing to piles. The existence of other *diseases about the rectum and anus,* such as fistula, ulcer, or stricture, by inducing local congestion and irritation, may excite the disease; so also, *uterine affections* and various *diseases of the genito-urinary organs* may give rise to this affection.

The most direct exciting cause of piles is certainly a *retardation to the return of the portal blood.* Any impediment to the onward current of the blood through the hæmorrhoidal or mesenteric veins, the trunk or ramifications of the vena portæ, exercises a marked influence on the tendency to congestion of the hæmorrhoidal plexus. Habitual constipation; the accumulation of hardened feculent masses in the large intestine; the want of due secretion from the mucous surface; obstruction to the proper action of the liver, and consequent congestion of that organ; the pressure of abdominal tumours, or of the gravid uterus, are all active exciting causes, interfering as they do with the proper return of the portal blood. In some cases, even the existence of an obstacle to the circulation in the systemic veins may occasion this disease; thus it will arise from the pressure of an aneurismal tumour on some of the large venous trunks within the chest.

STRUCTURE.—A pile, whether external or internal, consists essentially in the first instance of a varicose condition of a portion of the hæmorrhoidal plexus, or rather, of the small veins of the submucous tissue that pour their contents into this; this varicose condition, becoming prominently developed at certain points, gives rise to small knots or tumours. A pile in this state is quite soft and compressible, and can readily be emptied by pressure; and when cut into, it will be found to be composed of one or more cells filled with blood, and surrounded by areolar tissue. The appearance of cells is, however, deceptive, and is occasioned by a section of the sacculated and dilated veins that enter into the composition of the tumour. After the piles have existed for some little time, or after they have once become inflamed, the tissues that enter into their composition undergo modifications that induce corresponding alterations in the character of the tumour. The coats of the veins become thickened;

their cellular dilatations are filled with coagulated blood; the investing areolar tissue is hypertrophied or thickened by plastic deposit; and, on being cut into, the pile is seen to be composed of a spongy kind of tissue filled with blood. External piles, when examined after removal, often resemble in structure a mass of hypertrophied areolar tissue, infiltrated with plastic matter, in which a number of small vessels of uniform character ramify, but without any appearance of cells. Internal piles, on the contrary, contain more of the venous, and less of the areolar element. They are also commonly furnished with a small central artery, which is apt to bleed freely, or even dangerously, if the tumour be cut across; hence, provided they are not clogged with coagulated blood, they may readily be injected from the inferior mesenteric artery.

In studying the structure of hæmorrhoids, it is of importance to observe that they occur under two different forms: one in which there are distinct tumours, within or external to the anus, and another in which there is merely a varicose condition of the veins of this region, without distinct intumescence.

In those cases in which there is merely a general varicose state of the veins of the submucous areolar tissue of the anus, without any distinct tumour springing above the level of the membrane, it will be found that the smaller branches of the hæmorrhoidal plexus, and the small twigs that enter these from the submucous areolar tissue, have undergone varicose dilatation, being apparently greatly increased in number, as well as in size. The mucous membrane is of a deep mulberry or port-wine colour, and becomes everted after each motion. There is usually some mucous secretion about the anus, rendering the part moist: and the patient complains at times of weight and of bearing down, with pains either in the part itself, in the sacro-lumbar region, or in the thighs. The motions, more especially if hard, are streaked with blood, and more or less of this fluid drops in a rapid manner after the passage of the fæces. There is seldom much blood lost; but at times there is an exacerbation of all these symptoms, and the hæmorrhage, as will more particularly be mentioned hereafter, may become very abundant. This condition of the mucous membrane may precede, and is frequently found to accompany the true pile, whether external or internal, and may be looked upon as constituting the first stage of this disease. If this state of things be allowed to continue unrelieved, the tendency to congestion increases; more and more of the mucous membrane is everted and protruded after defecation; the submucous areolar tissue becomes stretched and lax, and the case is apt to become one of prolapsus ani.

**External Hæmorrhoids** are those that are situated below the verge of the anus, and that are invested by cutaneous, or, at most, by muco-cutaneous tissue. Before appearing as defined tumours, they usually constitute longitudinal folds that surround the anal aperture, or radiate from it as from a centre. In colour, they vary from that of the natural structures to a pink or purplish hue; and, their tegumentary covering consisting of the thin skin of the part, they resemble folds of this tissue rather than of mucous membrane. Their size varies, according to the state of congestion; and hence the same tumour may at one time be soft, flaccid, and loose, apparently nothing more than a fold of integument, and at another may become tense, tumid, and ready to burst.

*Symptoms.*—When of small size and recent formation, external piles do not in general give rise to much distress, but merely some local heat, pricking, and itching, with a sense of fulness after defecation; but when of large size, and inflamed or irritated, they may occasion very acute suffering. There is not only deeply seated, dull, aching and throbbing pain in the pile itself, but this shoots up the side of the rectum, through the perinæum, and into the nates, and is much increased when the patient stands or walks. After a few days these symptoms subside; suppuration either taking place in the pile, or the blood contained in it coagulating. The parts are, however, left in a thickened and indurated state, and do not really resume their former soft and flaccid condition, effusion of plastic matter taking place into the areolar tissue, and the contained blood perhaps coagulating, so that the tumour can no longer be emptied by pressure, assuming the form of a broad, rounded, or indurated mass.

**Internal Piles.**—When the pile is situated altogether within the verge of the anus, it is called internal; of these there are two principal varieties, the *Longitudinal* and the *Globular*.

The **Longitudinal,** or, as it is sometimes called, the **Fleshy** pile, is generally met with about an inch or two up the rectum. It is spongy, elastic, firm, or tough, of a dark reddish or dusky brown tint, tapering upwards from a broad base. It seldom bleeds or varies much in size; between the piles are found small curtains, valves, or folds of mucous membrane, forming sacculi or pouches, with their concavities looking upwards. These sacculi are apt to become distended and pressed downwards by the fæces, especially if the motions be hard and the bowels have been constipated, thus giving rise to a tendency to prolapsus.

When the hæmorrhoid assumes a **Globular** form, it constitutes the ordinary bleeding pile. It may be situated on a broad base; or, as not unfrequently happens, its point of attachment to the mucous membrane becoming elongated, it assumes a pedunculated shape, hanging downwards into the cavity of the rectum. It is of a dark bluish colour, and numerous small vessels of a brighter hue than the body of the pile may be seen ramifying on the mucous membrane investing it. Its surface is at first smooth and shining, and may continue so throughout, being covered with a thin and delicate prolongation of the lining membrane of the gut. Not unfrequently, however, superficial ulceration takes place, and then it has a granulated strawberry-like appearance.

*Symptoms.*—Internal piles are usually attended by a sensation of heat, itching, pricking, or smarting about the anus, and a feeling as if there were a foreign body within the gut. After defecation these sensations are increased, and are often accompanied by a bearing down, as if the bowel were not emptied of its contents, that is peculiarly distressing and sickening. This is occasioned by the piles, or the elongated and condensed mucous membrane to which they are attached, being protruded during the expulsion of the fæces, and not returning sufficiently quickly, being grasped by the sphincter ani and constricted by it. This feeling of discomfort and bearing down is much increased, if the patient stand or walk much after having had a stool, or if he have a confined state of the bowels. If this state of things be not properly attended to, the symptoms become increased in severity; the bearing-down sensation amounts to true tenesmus, and the act of defecation becomes so painful that the patient defers it as long as possible, and then when it does take place, in consequence of the accumulation of the excreta and their indurated character, the suffering is much increased. Internal piles now usually make their appearance, if they have not existed before ; the mucous membrane of the rectum becomes prolapsed, and an increased secretion of thin mucus takes place from the orifice of the gut, moistening the part and soiling the patient's linen. Irritation in the neighbouring organs is frequently set up ; occasionally to so great an extent as to mask the original complaint, the patient referring his principal pain and discomfort to these sympathetic disturbances. There is often a dull aching fixed pain at the lower part of the lumbar spine, and more frequently opposite the sacrum or the sacro-iliac articulation on either side ; this is sometimes very severe, perhaps down the thigh, or round the groins ; irritability of the testicles may come on, or irritation about the neck of the bladder, causing frequent desire to micturate, and increasing the patient's sufferings by the straining that takes place. The general health now suffers, the patient may become emaciated, and the countenance often presents a peculiarly anxious, drawn, and careworn look.

The symptom, however, that first of all and most prominently fixes the patient's attention, is **Hæmorrhage.** This varies greatly in quantity ; at first there may merely be a few drops falling after the passage of a motion, or the cylinder of fæces may be stained on one side by a streak or spots of blood, or the bleeding may amount to several ounces or even pints. When moderate in quantity, it often affords relief to the other local symptoms, and seldom proves injurious from the quantity lost at one time ; but, if profuse, and occurring at short intervals, its effects on the constitution may be alarming.

The hæmorrhoidal flux is connected with, and in the great majority of cases dependent upon, the existence of distinct hæmorrhoidal tumours. Occasionally, however, it appears to occur when there is no distinct separate tumour projecting above the surface of the membrane ; but in these cases there is general intumescence and congestion of the whole of the mucous membrane of the lower part of the rectum, from which the blood exudes in drops, or it may even spirt in a distinct jet from the open mouth of a blood-vessel.

It is frequently ushered in by an exacerbation of those symptoms that commonly accompany piles, such as a sensation of fulness, weight, and tension about the parts. But the symptoms that precede its occurrence are often much more imperfectly marked than is usually stated, and are frequently absent altogether.

The discharge of blood may be periodical, occurring every month, or at intervals of two, three, or six months ; and it may be remittent or intermittent. When once it has set in, it usually continues from three to six days, increasing in quantity up to the third or fourth day, and then lessening.

When moderate in quantity and short in duration, it is often a source of relief to the patient ; but if a very large quantity be lost at one time, or if it continue for too long a period, it becomes a source of great debility ; more harm is usually done to the patient by its long continuance, than by its excessive quantity at any one time. The patient may become much debilitated and anæmic; nervous headaches, pallor, palpitations, and syncope may result. In some cases this discharge is of service, acting as a derivative, and preventing disease from falling on more important parts; it has especially been looked upon as, and doubtless is in many cases, a safeguard from apoplexy and visceral congestions and obstructions, particularly when it occurs in plethoric and corpulent persons who habitually live too highly. In other cases it may be considered as critical; especially when it occurs about the cessation of the menstrual period. But, as a rule, the continued loss of blood from piles is undoubtedly injurious to the patient's constitution.

Hæmorrhage from piles is sometimes vicarious with, and at other times arrests, the menstrual flow. In a case, which I attended with Garrod, the patient had suffered from the hæmorrhoidal flux and piles from the age of puberty. She menstruated for the first time when thirty-seven years old; up to that period the hæmorrhoidal discharge had occurred abundantly at monthly intervals. After the late establishment of the menstrual function, the piles continued to bleed, but less regularly, and she became anæmic, emaciated, and debilitated to the last degree. When she was forty-four years of age, I saw her for the first time; the piles, which were very large and vascular, were ligatured, and she made a most perfect recovery in general health.

The colour of the blood is most generally florid, as if it came from the small arteries or capillaries of the part rather than from the veins. It would appear that, in consequence of the over-distended and varicose condition of the veins of the part, the onward flow through the arteries and capillaries leading to them is obstructed; and that, in consequence of the accumulated pressure on those vessels, their parietes give way, allowing the florid blood to escape from the arteries.

Very commonly the internal piles, when brought down, present a somewhat granular surface, in consequence of ulceration having taken place, and the whole surface will be seen to exude blood in drops. In other instances, the blood appears to come from a cavity in one side of the hæmorrhoid, as if rupture had occurred from over-distension at that part. Occasionally, however, the flow of blood is so rapid and copious that it cannot be supposed to come from exudation, but would appear to depend on rupture of the vessels of the part.

The hæmorrhoidal flux may be accompanied by, or alternate with, a thin glairy mucous discharge from the rectum and diseased structures; this would appear to be nothing more than excessive secretion from the membrane, in consequence of the irritation set up by the presence of the piles; it is seldom in sufficient quantity to produce much annoyance, or to be of much moment to the patient.

COMPLICATIONS.—Piles are not uncommonly complicated with other diseases of the rectum, such as fissures, fistula, or prolapsus. When connected with fissure, the hæmorrhoid often, as Syme has remarked, assumes a peculiar form and appearance, presenting itself as a small red-coloured body, like a pea in size, firm, and seated at the base of the fissure, which it often conceals; to a practised eye, however, the presence of a pile of this peculiar colour and shape is sufficient to indicate the existence of the fissure.

In that form of fistula in which the aperture is near the anus, one or more external piles of small size are often found situated at the orifice of the fistula; and prolapsus rarely, if ever, is met with in adults, without the simultaneous occurrence of piles.

TERMINATIONS.—Hæmorrhoidal tumours may terminate by Subsidence, Coagulation, Suppuration, or Sphacelus.

**Subsidence.**—Complete subsidence of the pile can only take place when the disease is of recent occurrence. When of long standing, and after it has been exposed to successive attacks of inflammation and turgescence, it never subsides completely; and the areolar tissue and the muco-cutaneous structures, becoming hypertrophied, form elongated pendulous flaps around the margin of the anus.

**Coagulation** of the contents of the pile is the result of inflammation having taken place in it, and probably terminating in plastic effusion by which the vessels leading from it are obstructed. When it takes place, the tumour, after more or less active inflammation, becomes hard, incompressible, and indolent, permanent in size, and of a purplish or plum colour. The coagulum thus formed may remain persistent, may excite suppuration, or may be absorbed, the hypertrophied tissues forming one of the usual anal folds. In some rare instances, the coagula may become converted into structures resembling phlebolithes.

Coagulation more frequently takes place in external than in internal piles, owing to the great impediment to the return of the blood from them, and to their greater liability to inflammation, their exposed situation leading them to be bruised or otherwise injured. When it occurs in internal piles, it most commonly affects those that are of a columnar or longitudinal shape, and least frequently the globular variety.

**Suppuration** is not an uncommon termination, if acute inflammation have been set up in internal piles, more especially in those that have previously been coagulated. When the abscess is discharged, small coagula escape with its contents, the cavity granulates, and becomes obliterated, and the pile is cured.

**Sphacelus.**—In some cases, when there is much elongation of the mucous membrane from which the pile springs, prolapsus of that membrane and of the piles may take place; and, this being grasped after it has descended by the contraction of the sphincter, the same effect may be produced as if a ligature were applied. The tumour becomes much swollen, hard, livid, and tense; there are much constitutional disturbance and restlessness; but after a few days the part that is constricted sloughs and drops off, and all the symptoms are relieved.

DIAGNOSIS.—The diagnosis must be regarded in two points of view;—1, as concerns the *Hæmorrhoidal Tumours;* and 2, with reference to the *Hæmorrhoidal Flux.*

1. **Hæmorrhoidal Tumours** must be diagnosed from prolapsus ani, polypus of the rectum, and condylomata about the anus. From **prolapsus** the diagnosis is not always easy; indeed, the two diseases are so generally associated, that it is of little moment to attempt it. In true prolapsus, ocular examination will suffice to distinguish the membranous wall of the intestine, forming a

smooth, rounded, and somewhat lobulated annular protuberance, from the isolated tumours of piles. In **polypus** the history of the case, the pedunculated and solitary character of the tumour, its large size, and comparatively slight tendency to periodical hæmorrhage, will enable the Surgeon to make the diagnosis. From **condylomata** the diagnosis is easy; the soft, flat, mucous, and wart-like character of these growths, their history, and their occurrence at other points, as the perinæum, scrotum, vulva, and buttocks, will enable the Surgeon to distinguish them without any difficulty.

2. The **Hæmorrhoidal Flux** must be distinguished from other **intestinal hæmorrhages.** This may be done by attention to the character of the blood, which will enable us in many cases to determine its source. When it comes from piles it is liquid, of a more or less florid colour; and not unfrequently is quite bright, staining or coating the fæces rather than being mixed up with them. When, on the contrary, the blood is poured out at some higher point in the intestinal canal than the usual seat of hæmorrhoids, it is of a dark, sooty character, mixed up with liquid fæces either in a diffused form or in small black coagula, and no fresh or bright blood will be visible. Digital exploration of the rectum in cases of piles, and the presence of symptoms indicating the existence of mischief at a higher part of the intestine than the anus in cases of melæna, will also serve to point to the seat of the flux.

TREATMENT.—In conducting the treatment of a case of piles, that Surgeon will succeed best who looks upon the disease not as a local affection, merely requiring manual interference, but as a symptom, or rather an effect, of remote visceral obstruction and disease, the removal of which may alone be sufficient to accomplish the cure, without the necessity of any local interference; or, should it be thought necessary to have recourse to operative procedure, this must be made secondary to the removal of those conditions that have primarily occasioned the congestion and dilatation of the hæmorrhoidal vessels. The treatment of piles, therefore, must be considered, 1, as regards the Removal of these Constitutional Conditions or Visceral Obstructions that occasion the disease, together with any Topical Applications that may be considered necessary; and, 2, with reference to the Operative Procedures that may be required for the removal of the affection.

1. The **Constitutional Management** of piles necessarily varies considerably according to the condition of the patient in whom they occur, and the visceral obstruction to which they may be referrable. Thus, when they occur in debilitated persons, apparently from relaxation of the vessels, most benefit will be derived from a mild tonic and nutritious plan, at the same time that the bowels are kept regular by some of the aperients that will immediately be mentioned. In these cases, also, much advantage is often obtained by the administration of the confection of black pepper, which acts as a useful local stimulant to the vessels of the rectum. In the great majority of instances, however, more particularly when occurring about the middle period of life, piles are connected with a plethoric state of system, and obstruction of the abdominal viscera. In these circumstances, our efforts should be directed to the reduction of the plethoric condition, by putting the patient upon a proper regimen, prohibiting the use of stimulants, and lessening the quantity of animal food that he is in the habit of taking. When piles arise from the

pressure of a gravid uterus or other abdominal tumour, little can be done; except, by local palliatives and mild aperients, to moderate the inconvenience attending them.

In all cases of piles, but more particularly in those arising from hepatic obstruction, mild aperients are of essential service; by removing feculent accumulations, and establishing a free secretion from the intestinal surface, they tend materially to prevent congestion of the portal system. At the same time, drastic purgatives of all kinds should carefully be avoided. The most useful aperients are the electuary of senna, sulphur, and castor-oil; one or other of which should be taken regularly twice or thrice a week at bed-time, in as small a quantity as will be sufficient to keep the bowels free. In many cases, the confection of senna may advantageously be given in combination with precipitated sulphur and the bitartrate of potash, equal parts of each of these being made into a mass with twice their quantity of the confection and a little syrup; of this electuary a dessert-spoonful may be taken every night or every second night. If there be a relaxed condition of the rectum and anus conjoined with the piles, as not unfrequently happens in old as well as in young people, the administration of an electuary composed of equal parts of the confections of senna and of black pepper, or of cubebs, will be found very useful. In fact, in all cases in which the black pepper is administered, an aperient should be given from time to time, to prevent its accumulation in the large intestine. When the liver is much obstructed, the treatment should be specially directed to the relief of this organ; with this view, a course of Plummer's pill, followed by taraxacum, and, in relaxed constitutions, the mineral acids, will be found especially serviceable, at the same time that the bowels are kept free by gentle aperients.

The habitual use of lavements, consisting either of soap and water or thin gruel, will be found advantageous in many cases of piles, though in some they appear to irritate, and rather to increase the disease. When the piles occur in relaxed constitutions, the lavement should be used cold; but when the patient is of full habit of body, a tepid one will usually be found to agree best. In the general management of piles, it need scarcely be observed that any habits which favour the disease should be sedulously avoided.

The **Local Treatment** of piles is of considerable importance. The parts should be regularly sponged with cold water, morning and evening. If there be much relaxation, and the piles be internal, benefit may result from the employment of some astringent injection, such as a very weak solution of the sulphate of iron, or of the tincture of the sesquichloride—a grain of the first or ten drops of the second, to an ounce of water; of this about two ounces may be injected every night and left in the rectum. The application of an astringent ointment, such as the unguentum gallæ compositum, or the employment of the anodyne and astringent suppository already recommended, will be attended with much benefit.

If the piles become inflamed, the patient should keep his bed, and leeches should be freely applied around but not upon the tumours. Tepid lotions, poultices, and poppy fomentations, must be assiduously used, a very spare diet enjoined, and the bowels opened by mild saline aperients. If a coagulum form in an external pile, as the result of inflammation, the tumour should be laid open with a lancet, and its contents either squeezed, or turned out with the flat end of a director. If abscess form, it must be punctured in the usual way, and the part afterwards poulticed. Should strangulation of the piles take place, the protruded swelling must be returned by gentle steady pressure, and the part afterwards well poulticed.

2. **Operation.**—The means above indicated are usually sufficient in ordinary cases of piles; but if the disease attain an inconvenient size, giving rise to general irritation and local uneasiness, or if the abundance of the hæmorrhage be such as seriously to interfere with the health of the patient, it will become necessary at last to have recourse to operative interference, with a view of removing the diseased structures. No operation should ever be undertaken whilst the pile is in an inflamed state, lest unhealthy inflammatory action to an undue extent be set up in the part; it is also well to get the patient's health into a good state, as erysipelas may otherwise follow the operation; and before proceeding to perform it, care should be taken that the bowels have been well opened.

There are three plans of treatment adopted by Surgeons for the removal of piles; viz., the excision of the tumour, its strangulation by ligature, or destruction by caustics. These methods of treatment should not be employed indiscriminately. The first is alone applicable to external piles; the last two may be adopted in the internal form of the disease.

**Excision.**—The removal of external piles is readily effected. The tumour should be seized with a vulsellum or hook, drawn forwards, and snipped off with a pair of knife-edged scissors, curved upon the flat. At the same time when the external piles are removed in this way, any pendulous flaps of skin in their vicinity should be excised, lest they become irritated, and constitute the basis of a fresh pile. After the excision of external piles, there is usually but trifling hæmorrhage, which may readily be arrested by the application of cold lint, or a pad and T-bandage; should any small artery bleed, it may be pinched, and the hæmorrhage thus stopped. The hæmorrhage attendant on this little operation is sometimes rather profuse.

**Ligature.**—Internal piles are usually removed by the ligature; in fact, it may be laid down as a rule in surgery, that all external piles should be cut off and all internal piles tied. The reason of this difference in the practice to be adopted, according as the pile is situated above or below the margin of the anus, is the liability to hæmorrhage in the one case, but not in the other. The bleeding that follows the excision of an external pile is not only small in quantity, but may readily be arrested by cold or pressure. With internal piles, however, it is different; these tumours are not only more vascular, being often fed by a large central arterial twig, but are deeply seated, and do not readily admit of the application of means for the arrest of the flow of blood from them. So difficult is it to stop the bleeding from an internal pile in some cases, that patients have actually lost their lives from this cause after its excision, even in the hands of some of the most distinguished Surgeons. The excision of internal piles has consequently been very properly abandoned.

The *Operation for the Ligature of Internal Piles* may most conveniently be conducted in the following manner. The patient, having had his bowels cleared out by a dose of castor-oil on the day preceding that fixed for the operation, should have an abundant lavement of warm water administered about an hour before the Surgeon arrives; and he should then be directed to sit for half an hour on a bidet, or over a pan containing hot water, bearing down at the same time, so as to cause the piles to protrude. When all is ready, he should be laid on the bed on his left side, with the nates well projecting; the Surgeon then seizes the most prominent pile with a hook, vulsellum, or ring-forceps (Fig. 702), draws it well forwards, and ties its base as tightly as possible with a thin whipcord ligature. The ring-forceps may be tightened by a clip or by a strong India-rubber ring on the shanks, which closes them if drawn down to the handles. He does the same to one pile after the other, until all that can be met with have been strangulated in this way. In some cases the pile is so broad at the base, that the ligature will not include it. In such cases some Surgeons employ transfixion; this may usually be done readily enough by means of a nævus-needle, or by the instrument represented in the annexed drawing (Fig. 703), Bushe's Needle, which consists of a steel shank fixed in an ivory handle, and having its free end perforated for the reception of a needle-eye near its point. In this instrument not only is the angle formed by the needle and the shank a very convenient one for passing a ligature through a pile inside the anus, but more particularly, as the needle can be detached, it may, as soon as it is carried across the base of the tumour, be separated and so withdrawn more readily than it otherwise could. Transfixion of the pile and its ligature in two halves is, however, a very dangerous procedure, and should never be had recourse to if it can possibly be avoided. The danger of this operation consists in the possibility of a hæmorrhoidal vein being transfixed, and the two halves then tied separately. In this way the vessel is left open and cannot collapse, and the risk of direct septic absorption becomes very great.

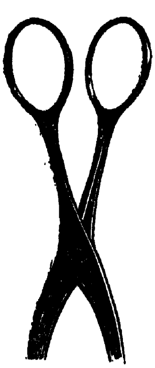


Fig. 702. Ring Forceps.

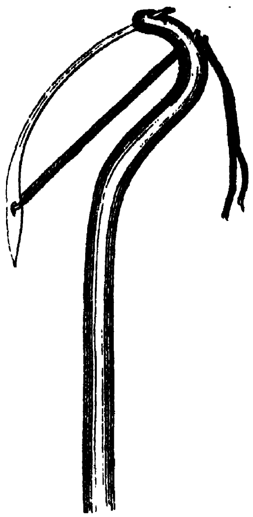


Fig. 703.—Bushe's Needle for applying Ligature to Piles.

Transfixion may usually be avoided when the pile is large and round, by snipping through the cutaneous portion by means of curved scissors, thus leaving a deep groove for the reception of the ligature, which then constricts only the substance and mucous surface of the hæmorrhoid. If the pile be longitudinal, it may be deeply notched with scissors in a direction upwards at its lower attachment, at the line of junction between the skin and mucous membrane, and the ligature tied in the groove thus formed. In whatever way the ligatures are applied, care should be taken that they are tied as tightly as possible, so that the piles may be effectually strangled at once; as in this way they separate much more readily, and with far less pain to the patient than if loosely tied. When all the tumours requiring ligature have been tied, the ends of the threads must be cut off close, and the strangulated mass pushed back into the bowel. If there be any external piles, these must now be cut off; for, unless this be done, they become irritated, swollen, and inflamed by the presence of the ligatures, and constitute a source of much distress. The patient must now return to bed, and should keep the recumbent posture until the ligatures separate, which usually happens from the sixth to the eighth day, when an ulcerated surface will be left, which, however, speedily closes and contracts. In some cases this process may be facilitated by the application of the nitrate of silver through a speculum ani. On the second day after the operation, the bowels may be opened with a dose of castor-oil.

In the *after-treatment* of the case, care must be taken to prevent the recurrence of those causes that gave rise to the affection in the first instance. After piles have been tied, more particularly if they be seated towards the anterior part of the rectum, there is frequently great irritation set up about the neck of the bladder, so that the patient experiences difficulty in passing his urine, and sometimes suffers from complete retention; a warm hip-bath, and a full dose of hyoscyamus and nitrous ether, will usually relieve this, and enable the urine to pass. In some cases, when the external piles are very large and vascular, and the patient debilitated, the ordinary rule of cutting them off may advantageously be deviated from, and a combination of the treatment by excision and ligature be adopted. In such cases an incision may be made through the integuments merely, and then the piles tied in the course of the groove thus formed. By these means the pain and constitutional disturbance consequent on the inclusion of a portion of the integument in the ligature are avoided, at the same time that the risk of hæmorrhage is not incurred.

The treatment of piles by ligature is not altogether devoid of danger in persons of broken constitution. I have more than once known death from pyæmia result in these cases.

*Smith's Operation.*—Piles may be removed with but little fear of hæmorrhage by the method introduced by H. Smith, which is as follows. The pile is brought down and seized in a clamp (Fig. 704), fixed by a few turns of the screw, and cut off not too close to the clamp. The cut surface is then seared with a cauterising iron, by which hæmorrhage is prevented and cicatrisation facilitated.

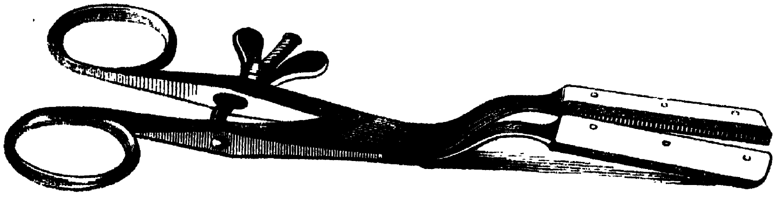


Fig. 704.—Smith's Clamp.

**The Removal of Piles by the Galvanic Ecraseur** may easily and safely be effected, the pile being drawn down with ring-forceps, and its base constricted by the platinum wire of the écraseur, which, being tightened, cuts off the projecting mass very readily. This treatment is, however, only to be adopted for internal piles. In them, it has the great advantage of preventing all hæmorrhage by the searing of the cut surface by the hot wire; and the contraction of the resulting cicatrix after the separation of the slough, tends still further to obliterate all dilated hæmorrhoidal vessels.

**Caustics.**—In certain kinds of internal piles, the application of nitric acid has been recommended by Houston of Dublin and H. Lee, and may certainly advantageously be adopted. It must not, however, be applied to the external or to the intero-external pile, as it will produce extreme irritation ; nor can it be looked upon as a substitute for the ligature in internal piles generally. It is especially in the granular pile, having an ulcerated surface, that this mode of treatment is useful ; as in these cases it appears, by destroying a portion of the mucous membrane, not only to cure the pile to which it is applied, but, by producing an ulcer, to give rise to a cicatrix, which, by contracting, consolidates the parts in its vicinity, and so lessens the relaxed state of the rectum, which favours the hæmorrhoidal tendency. The acid may conveniently be applied through a speculum ani, having an aperture on one side (Fig. 705). This should be introduced well oiled, until the pile projects through the opening in it, when it must be freely rubbed with a piece of stick, or a glass rod, or brush, dipped in the acid ; the surface is then immediately wiped with a piece of lint saturated with prepared chalk and water, and the instrument removed. Or the gilt clip (Fig. 706) may be used, so as to effectually protect the neighbouring parts from the action of the acid. A thin slough separates, leaving a raw surface, which gradually cicatrises and contracts. The application of the acid occasions but little pain when fairly made within the rectum ; but if a drop of it accidentally come into contact with the muco-cutaneous surface, a vast deal of irritation and inflammation is excited. This plan of treatment, though useful in particular forms of pile, as when the tumour is granular or flat, so as not to allow ready removal by the ligature, should not be practised when the ligature can be employed, as it is by no means so certain a mode of treatment. It cannot be considered altogether devoid of risk ; for I have known one instance in which fatal erysipelas followed the cauterisation of piles with nitric acid.

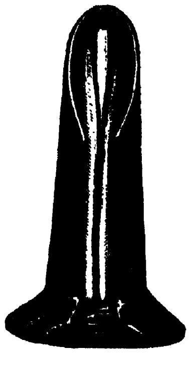


Fig. 705 — Speculum Ani.

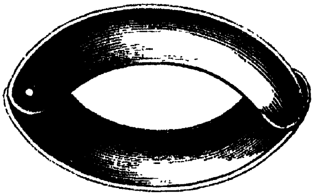


Fig. 706.—Gilt Clip.

*Dangers attending Operation for Piles.*—The operation for the removal of piles may be attended by three sources of danger. After excision, and even the application of the ligature or of nitric acid, erysipelas may develop. If the objectionable practice of transfixing the pile by the needle be followed, and it be tied in two separate parts, a hæmorrhoidal vein may thus be opened, and its sides held apart by the action of the ligatures, and thus a tendency to direct pyæmic infection be induced ; and lastly, I have seen a kind of erysipelatous colitis induced, leading to profuse muco-purulent discharge and high fever. I have also in one case seen pelvic cellutitis set up. But all these various secondary affections—erysipelas, pyæmia, colitis, and cellutitis—are happily of rare occurrence.

A permanently **moist condition of the skin around the anus** is not unfrequent, as the result of portal congestion or a hæmorrhoidal tendency. It is best removed by the habitual use of aperient salines, or of aperient mineral waters, as those of Pullna or Friedrichshall.

**Pruritus Ani** is often an extremely troublesome affection, the itching and general irritation about the anus being almost unbearable. In many instances it appears to be a true prurigo of this part; in other cases it seems to be connected with the irritation of external piles, worms, or some similar affection. The *Treatment* must in a great measure have reference to the cause. If there be an external pile, the removal of it, or if worms, their expulsion, will probably cure the disease. If it arise from prurigo, it will require some special treatment. In some cases the arsenical preparations will be found useful, together with the local application of chlorinated lotions, or those containing hydrocyanic acid.

### PROLAPSUS ANI.

**Prolapsus Ani** consists in a protrusion of the mucous membrane of the rectum through the anal orifice; the areolar tissue that lies underneath it being also in the majority of instances much thickened and elongated. In the ordinary prolapsus, the muscular structures of the gut are not protruded; yet occasionally the muscular coat descends with the mucous membrane, an invagination of the bowel taking place, which constitutes a far more serious condition than the ordinary prolapsus.

CAUSES.—Prolapsus not unfrequently occurs in children, especially those who are feeble, or who suffer from much irritation of the digestive or urinary organs. In weakly persons generally there is a natural tendency to prolapsus; the slight protrusion of the mucous membrane which takes place during defecation being increased by any constitutional condition that gives rise to atony of the muscular system, especially if irritation of the intestinal mucous membrane be conjoined with this, as in dysentery, chronic diarrhœa, &c. So again, the habitual constipation, often occurring in persons of a relaxed habit of body, apparently proceeding from want of power in the rectum to expel its contents, and requiring constant straining at stool, predisposes to this affection. It is especially common in those who labour under stricture, stone, or any other disease about the urinary organs that require a considerable effort to be made in expelling the contents of the bladder. In persons whose constitution has been relaxed by a long residence in India, this disease also frequently occurs. In other cases, and indeed most usually, the prolapsus is associated with piles, the weight and dragging of the hæmorrhoid drawing down the mucous membrane with it. This is especially apt to happen, when there is general hæmorrhoidal tendency about the anus. In fact, the causes of prolapsus may be summed up under three heads; 1. Simple relaxation of tissue, such as is met with in children and in weakly persons; 2. Sympathetic irritation, as in chronic tenesmus, stone in the bladder, &c.; 3. A hæmorrhoidal or polypoid condition of the mucous membrane of the rectum.

DIAGNOSIS.—Prolapsus is readily recognised. It consists in the protrusion of a ring of mucous membrane of a red or purplish colour, and having a somewhat turgid look, rather lobulated in shape, and varying in size from half a walnut to a small orange (Fig. 707). The mucous membrane covering this ring will be found to be continuous with that investing the sphincter, and this constitutes the mark of distinction between ordinary prolapsus and invagination of the whole thickness of the gut; for in the latter affection, which is extremely rare, there is a deep and distinct sulcus between the protrusion and the margin of the sphincter. In prolapsus there is, when the protrusion is down, a dragging and smarting sensation, often attended with a good deal of spasm about the neck of the bladder, and not unfrequently with symptoms of stricture. In chronic cases, the anal aperture appears to be permanently relaxed ; and, on introducing the finger into it, it is found to be widened and weakened. The folds of skin in its neighbourhood are relaxed and elongated, radiating from it as from a centre; they are commonly bluish, soft, somewhat swollen, and pendulous, and often the seat of a good deal of irritation. The protrusion at first occurs only after defecation, and then readily goes back of itself, or is reduced by steady pressure upon it ; after a time, however, it will come down at other periods ; thus it may protrude after riding, walking, or even standing, and is returned with much difficulty.

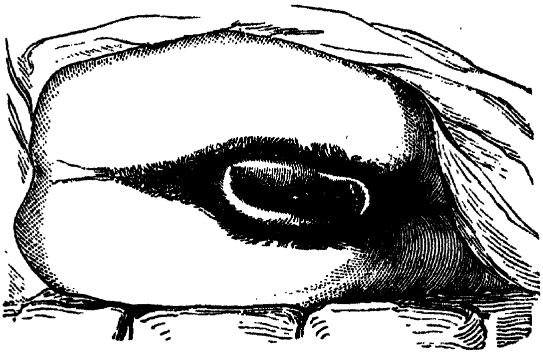


Fig. 707.—Prolapsus Ani.

Strangulation of the prolapsus may occasionally occur, if it be allowed to protrude for a considerable length of time without a proper attempt being made to push it back. It then becomes swollen and livid, with great pain and tenesmus, discharges a fetid ill-conditioned pus, and may eventually fall into a sloughy state, and thus separating, undergo a spontaneous cure.

There is a form of prolapsus that arises from complete atony of the levator and sphincter ani muscles. For this nothing can advantageously be done by operation. Palliation by simple support is the sole treatment.

Treatment.—The treatment of prolapsus may be said to be palliative and curative. The **Palliative Treatment** consists in the first place in reducing the tumour when protruded. This, in ordinary circumstances, the patient does for himself; but, if it become congested, it requires the help of the Surgeon to put it back. This may occasionally be readily done by laying the patient on his side, or making him lean over the back of a chair ; and then greasing the mass with some oil, seizing it with a soft towel, and gradually compressing it, working it back. It may be kept up by wearing a belt with a pad and elastic support. Olive-shaped pewter pessaries are occasionally employed, with the view of preventing the protrusion ; but I have never seen them of any service, the sphincter being usually too relaxed to keep them up, and their pressure appearing to excite irritation.

The regulation of the bowels is as important in prolapsus as in piles. It is usually best done by the administration of those laxatives that have been recommended for the latter disease. It is a good plan in prolapsus to get the patient to have his daily motion at bed-time instead of at the usual hour in the morning ; the recumbent position and the uniform temperature of the bed preventing the irritation of the sphincter and spasm of the anal muscles that commonly continue for some time after the reduction of the prolapsus, and which are a source of great discomfort when occurring in the early part of the day.

**Curative Treatment.**—The relaxation of the mucous membrane of the rectum that essentially constitutes prolapsus may often be obviated by astringent injections or suppositories. The best injection is that of the sulphate of iron, in the strength of from one to three grains in an ounce of water, thrown up in small quantities sufficient for the bowel to retain. In children, injections of this kind, conjoined with regulation of the bowels by mild aperients, the administration of a moderate quantity of unstimulating food, and afterwards the employment of tonics will commonly remove the disease, unless it arise from stone in the bladder, or some other affection inducing much and continued straining. In mild cases of prolapsus in adults, conjoined with a relaxed state of the mucous membrane of the rectum and relaxation of the sphincter, the use of the iron injection will be found particularly beneficial, at the same time that the action of the bowels is regulated by means of an electuary taken in the morning or at night. By thus giving tone to the bowel, at the same time that constipation is prevented, the disease will occasionally undergo a cure, provided it be not associated with any affection in other organs.

In those cases in which the prolapsus is hæmorrhoidal or polypoid, the protrusion being dragged down by the weight and strain of the pile or polypus, the same treatment must be adopted as has been recommended for the latter disease ; and usually, after the ligature and removal of the pile or polypus, the prolapsus will be cured. In slight cases of prolapsus, in which the disease appears rather to be owing to the relaxation of the sphincter and of the tissues external to it, the muco-cutaneous integument hanging in loose and pendulous folds around the anus, considerable benefit will commonly result from snipping of these pendulous flaps of skin ; the cut surface that is left cicatrising, and by its contraction bracing up the part, and thus preventing its further protrusion. These pendulous flaps are best removed in a direction radiating from the anal orifice, with curved knife-edged scissors.

When the prolapsus is considerable, and the ordinary palliative treatment after a proper trial fails in effecting a cure, it will be necessary to remove the protruded mucous membrane by operation. This should always be done by the application of the ligature ; excision, though easy, being objectionable in this as in the case of piles, on account of the danger from hæmorrhage.

**Application of Ligature.**—The patient having had the bowels freely opened on the preceding day, and an enema of tepid water on the morning of operation, should be directed to sit over a pan of hot water, in order to make the prolapsus descend ; it may then be seized with a pair of broad-ended forceps, such as are represented in Fig. 703, and drawn well forwards. The base must next be firmly tied with a strong piece of whipcord, and a similar process repeated on the opposite side of the anus. Should there be any difficulty on account of the shape of the protrusion in ligaturing the base firmly, this may be obviated by transfixing it with a hæmorrhoidal needle, and tying it on each side. I think, however, that it is better, if possible, to avoid doing this. The ends of the ligature must then be cut short, the whole protrusion returned into the bowel, the external flaps of skin cut off, and an opiate pill administered, so as to arrest all peristaltic action for a few days. Should the ulcerated surface show any difficulty in healing, it must be touched with the nitrate of silver. This operation always leaves a permanent cure.

The ligature of prolapsus, like that of *internal* piles, is not very painfu , and for it chloroform need not be administered ; indeed, it is, perhaps, better that it should not be given, as the protrusion is apt to slip up under its influence, the patient not being able to exercise the proper expulsive efforts. But, as the excision of the external flaps and piles is attended by very sharp suffering, it is as well to administer the anæsthetic at the time when they are being removed.

Should a prolapsus become strangulated, it would be necessary to try to reduce it through the sphincter by the employment of the taxis ; if this cannot readily be accomplished, free incisions may be made into it ; if it be not reduced, it will slough away, and thus undergo permanent cure.

**Invagination of the Rectum** occurs in some rare cases, and sometimes the portion that has descended through the anus has become strangulated. In such cases as these, reduction must be effected ; if possible without, but if necessary with, division of the sphincter.

I have already referred (p. 689) to the occasional protrusion through the anus of a chronic intussusception carrying with it the ileo-cæcal valve, and the necessity of care in not confounding this with a prolapsus of the mucous membrane.

A remarkable case has been recorded by Stocks, of Salford, in which an anal protrusion of the size of a cocoa-nut contained an ovarian cyst. This was removed by an incision through the coats of the bowel ; and, after the wound had healed, the bowel was returned.

# DISEASES OF THE GENITO-URINARY ORGANS.

## CHAPTER LXVII.

### SECONDARY DISEASES OF THE URINARY ORGANS ARISING FROM SURGICAL CAUSES.

THE great majority of cases of stone in the bladder, stricture of the urethra, cystitis secondary to paralysis, retention from enlarged prostate, tumours of the bladder, and, in short, of every disease tending to hinder the escape of urine from the bladder, or to induce chronic inflammation of that organ, terminate, if not relieved, by giving rise to fatal disease of the kidneys. This fact alone is sufficient to make the study of the secondary affections of the kidney of the greatest importance to the practical Surgeon; and the obscurity which surrounds their diagnosis, and the general impotence of treatment intended for their relief, renders the subject well worthy of the fullest investigation.

My friend and colleague, Marcus Beck, has for some years devoted much attention to the morbid changes thus induced. His pathological investigations in this very important department of Genito-urinary Diseases have been as careful and minute as they have been extended. The following pages will be found to contain a summary of the principal results at which he has arrived, for which I am indebted to him.

**Morbid Conditions of the Bladder.**—If we examine a case in which death has occurred from one of the above-named diseases, we find that the mucous membrane of the bladder shows signs of both recent and old *inflammation.* The recent is indicated by the swollen and softened condition of the mucous membrane, and the intense purple of the summits of the rugæ, and possibly by patches of ulceration, the ulcerated surfaces being often covered by a thick slough closely resembling diphtheritic membrane. The old inflammation is indicated by the dark slate-grey pigmentation which affects the greater part of the mucous membrane, and which has resulted from repeated attacks of intense congestion, in which red blood-corpuscles have become extravasated, and, after breaking up and becoming absorbed, have left their pigment behind them. The muscular wall of the bladder is found to be *hypertrophied,* or not, according to circumstances. If, in order to expel the urine, it have been called upon to make a greatly increased pressure on its contents, the hypertrophy will be very marked. If the obstruction to the flow of urine have been of a valvular nature, as is often the case in enlarged prostate, then *dilatation* of the bladder will greatly exceed the hypertrophy of the muscular walls. It may, therefore, always be supposed, when great hypertrophy with contraction of the bladder is found, that increased difficulty existed in expelling the urine, but the increased power of the bladder proved equal to the occasion. When dilatation is found combined with hypertrophy, we must conclude that increased power was required to expel the urine, but the increase of muscular tissue was not quite sufficient, and that the bladder suffered frequently from over-distension. When dilatation alone is found with scarcely any hypertrophy, we know either that the bladder has been paralysed, or that the obstruction to the exit of urine was valvular in nature, so that increased force applied to the contents of the bladder could only shut the valve more closely; and over-distension, with such an amount of stretching of the neck as to render the valve incompetent, was the only means by which urine could be passed without artificial aid. This last condition is peculiar to prostatic disease, and some cases of tumour of the bladder. In all cases of great hypertrophy of the muscular walls of the bladder, the bundles of fibres form ridges on the surface, giving rise to the condition known as *fasciculation.* In many cases in which great pressure has frequently existed in the bladder, either from the forcible contraction of its hypertrophied walls on the contained urine, or from simple over-distension from retention arising from a valvular obstruction in the prostate, the mucous membrane becomes thrust between the bundles of muscular fibres, so forming pouches called *sacculi.* These sacculi are most frequent in the posterior part of the bladder, and, in most cases, their walls are composed merely of mucous membrane and peritoneum. Sometimes, however, a layer of muscular fibres is also found. These sacculi form pouches in which putrid urine accumulates, and frequently gives rise to inflammation of the mucous membrane, sometimes ending in ulceration, and possibly perforation of the bladder. Much more often it gives rise to attacks of local peritonitis, and portions of intestine may so become glued to the bladder. (See also Chapter LXX.)

The *causes* which give rise to an increased demand for force in expulsion of the urine, and consequently to hypertrophy of the bladder, are various. The most common is perhaps obstruction in the urethra from stricture. In some cases it may arise from an irregular enlargement of the prostate in which the obstruction is not valvular in character. Villous growth and other tumours of the bladder may call for increased force, from partially obstructing the orifice of the urethra. Chronic cystitis, from the alteration it produces in the character of the urine, always causes more or less hypertrophy. Stone in the bladder causes obstruction to the flow of urine, partly mechanically and partly by the chronic cystitis to which it usually gives rise. The thick ropy mucus of chronic cystitis undoubtedly offers very considerable obstruction to the flow of urine. All these causes, therefore, may give rise to more or less hypertrophy. There is no evidence that mere frequency of action plays any important part in the production of hypertrophy. In the few recorded cases in which there was great frequency of micturition with healthy urine in cases of calculous pyelitis, no mention is made of any marked hypertrophy.

There is every reason to believe that hypertrophy of the bladder plays a very important part in the production of kidney-disease. In no case, as the result of obstruction to the exit of urine from the bladder, do we find the valves of the ureters incompetent. In the simple dilatation from valvular obstruction in the prostate, they are closed more firmly than natural. No regurgitation takes place, but of course the pressure in the ureters and kidneys will be increased, while the bladder is over-distended. In hypertrophy of the walls, we also find a certain amount of obstruction to the entrance of urine into the bladder, as the ureter has to pass obliquely through the thickened wall, and is doubtless often pressed on by thickened bands of fibres. The swelling of the mucous membrane at the orifice of the ureter in an inflamed bladder probably adds to this obstruction. Here then, although there may be no over-distension of the bladder, there is increased pressure in the ureters and kidneys, as increased force is required to drive the urine through the partially obstructed orifice of the ureter. The amount of obstruction offered by a hypertrophied bladder varies much, as it is not uncommon to find considerable thickening of the wall of the bladder without any marked signs of pressure in the ureters or kidneys. In cases of villous tumour of the bladder, one ureter and kidney only may be found to be affected, and it will then be seen that the growth implicates the orifice of that ureter. In others, both sides may be equally affected, and both orifices healthy, but it will then be found that the growth has obstructed the neck of the bladder, and that the signs of pressure in the ureters and kidneys are due to hypertrophy or over-distension of the bladder.

**Diseased Conditions of the Ureters and Pelvis of the Kidney.**—In such cases as we have been considering, three chief forms are met with: 1. The results of simple over-distension without acute inflammation: 2. Acute inflammation without signs of over-distension: 3. A combination of the two. Simple chronic over-distension leads to dilatation of the ureter and pelvis of the kidney, with some thickening of their walls. The thickening is in part due to hypertrophy of the muscular coat of the ureter. The mucous membrane is of an opaque white colour, and free from pigmentation or ulceration. At the same time that the ureter becomes dilated, it often seems to be increased somewhat in length, and is more or less tortuous, and not unfrequently irregular pouch-like dilatations occur. The dilatation is sometimes so great that the ureter resembles a piece of small intestine. (See Chapter LXXI.) In inflammation of the ureter and of the pelvis of the kidney, we find the mucous membrane swollen and softened, of an intense red colour, and frequently showing patches of a slate-grey, resulting from previous attacks, as in the bladder. Ulceration is not uncommon, and often the ulcers are coated with a tenacious slough like a diphtheritic membrane. The urine contained in such an ureter and pelvis is often ammoniacal and abominably fœtid, and mixed with much pus and mucus. There is every reason to believe that this is a consequence of extension of decomposition from the urine in the bladder to that in the ureter. The severity and acuteness of the inflammation in the ureter are probably due to the irritation of this foul and decomposing urine. But it by no means follows, because the urine in the bladder is decomposing, that the same condition extends up the ureter. In the great majority of cases, the extension of decomposition to the pelvis occurs late in the disease, and acts as the final cause of death, by exciting acute inflammation in the kidney. This extension does not take place on account of any incompetence of the valves or regurgitation of urine, as, on testing the valves in such cases they will be found to be competent. It probably creeps through the orifice of the ureter, by means of the mucus and inflammatory products, in the wake of the inflammation spreading by continuity of tissue from the bladder to the ureters. If after washing out a bladder with Condy's fluid, or some other antiseptic, the first urine that enters from the ureters and flows from the catheter be ammoniacal, the condition of the patient is always serious, as the decomposition has spread from the bladder to the pelvis of the kidney, where no local means can reach it.

**Morbid Conditions of the Kidney.**—The conditions found in the kidney itself vary considerably. They may be divided as follows: 1. Changes resulting from pressure by obstruction to the entrance of urine into the bladder: 2. Acute interstitial inflammation: 3. Acute interstitial inflammation with scattered abscesses: 4. The results of former acute or subacute attacks from which the patient has recovered.

1. *The Results of Pressure.*—A case lately occurred at University College Hospital, which afforded an opportunity of examining the uncomplicated effects of pressure with great advantage. The ureters had been pressed upon by two enormous sacculi, which projected from the bladder immediately behind the trigone. The bladder was much dilated and hypertrophied, but the cause of disease was uncertain. There were no signs of old or recent cystitis, and no instrument had been passed during life. In this case both ureters were greatly dilated, and the pelvis on each side was expanded so as to contain many ounces of fluid. The kidneys were somewhat increased in size, and before being opened felt like great thick walled bags of fluid giving all over a distinct sense of fluctuation. On being cut open, each presented the following appearances. The capsule was tough and opaque, and separated with difficulty from the kidney-substance, slightly tearing it in so doing, and leaving the surface coarse and irregular. The surface was uniformly pale, and whitish in colour. No trace of the pyramids was to be seen, but where each should have been was a deep hollow lined with a smooth membrane continuous with the pelvis of the kidney. The cortex was of about normal thickness, but in some parts thinner than natural; it was somewhat tough in consistence, and presented an uniform opaque whitish tint. The whole kidney was thus converted into a great sacculated bag, composed on one side of the dilated and thickened pelvis, and on the other of the expanded cortex of the kidney. There were no signs of past or present acute inflammation. On microscopic examination of a thin section of the cortex, the chief change noticeable was an abundant small round cell infiltration of the intertubular tissue of the kidney. Every tubule was separated from its neighbours by rapidly growing young connective tissue, crowded with small round cells, and this, by pressing on the vessels, had given rise to the pale colour above noted. The new growth was most abundant round the Malpighian bodies, the capsules of which were greatly thickened; so much so, that in many the vessels had been strangled and obliterated. The amount of change was not uniform, the new growth being more abundant in some parts than in others. The tubules themselves showed no great signs of change. They were slightly dilated in some parts, and the epithelium looked as if flattened by pressure, but in other respects it was perfectly healthy. This case shows that uncomplicated tension from partial obstruction of the ureter gives rise to a gradual absorption of the pyramids, and to a condition of interstitial inflammation of the kidney, probably varying in severity with the degree and acuteness of the obstruction. In more extreme cases than that above described,

the atrophy of the cortex becomes much more advanced, till nothing may be left but a layer of kidney-substance not thicker than a shilling. The microscope also shows more dilatation of the tubules and flattening of the epithelium. It is an interesting fact to be noted, that in the case above described the secretion of urine was abundant, its specific gravity was 1009, and it was free from albumen and casts. It is also evident that, if such a kidney as this were exposed to any additional source of irritation, more acute inflammation incompatible with life would readily be set up.

2. *Acute Diffuse Interstitial Inflammation.*—In this condition the kidney is soft and swollen. The capsule is opaque, and small vessels are seen ramifying in it. It separates easily, but tears the kidney-substance in so doing. The surface of the kidney is coarse and irregular. The colour of the surface is mottled, the greater part being usually of a pale yellowish tint intermixed with purple patches. Sometimes the mottling is very fine, almost granular. The venous stars always seen on the surface of the kidney are injected, and show out prominently. On section, the cortex is found to be abnormally soft, and to present the same mottled colour as the surface. Sometimes the part of the cortex corresponding to one pyramid may present a more uniformly pale appearance than that belonging to another. Small yellowish spots, looking like minute collections of pus, may be present, which are, however, on section found to be solid, though very soft. The pyramids are usually intensely injected, and contrast strongly with the paler cortex. Pale streaks can often be seen running parallel to the straight tubules. These are most frequent in those cases in which the pelvis is filled with putrid urine. The pelvis is found in some cases free from any signs of acute inflammation, though more frequently it is much affected and filled with foul urine and mucus. The appearances here described are often conjoined with the signs of pressure mentioned above, varying from mere flattening to complete destruction of the pyramids. The microscope shows that this condition is a mere exaggeration of that found as the result of simple pressure. The change is chiefly and primarily interstitial, but the small cell growth is so abundant as in many parts to press upon and even destroy the tubules, areas being found in which nothing but crowds of small round cells can be seen. These, when large, form the small yellowish spots visible to the naked eye. It only requires an increased intensity of the inflammation and a softening of these spots to convert them into minute abscesses. As in the form of interstitial nephritis first mentioned, the new growth is most marked round the Malpighian bodies. The change is rarely uniform throughout the kidney. It varies in degree usually in every field of the microscope, and parts may be found apparently almost healthy. The epithelium throughout the kidney is usually swollen and granular, and readily washes out in preparing the specimen, but it does not choke the tubules as in acute catarrhal nephritis. In very acute cases, small round cells, similar to those outside the tubules, are seen in the lumen of the tube surrounded by epithelium. These have probably found their way in from the outside, and, if washed on by the secretion from above, would appear as pus-cells in the urine. The vessels are often seen to be gorged with blood, and occasionally minute hæmorrhages are present. It is not always easy to distinguish this form of disease by the unaided eye, as, from the pallor caused by the pressure on the

vessels from the small cell infiltration, it closely resembles the fatty kidney or some cases of catarrhal nephritis. The microscope alone can decide the question with certainty. Even in such a kidney the secretion of urine may be moderately abundant. In a case at University College Hospital the patient excreted over 300 grains of urea on the last day of his life.

3. *Acute Interstitial Nephritis with Scattered Abscesses.*—(Suppuration of the kidney—suppurative nephritis: when accompanied by pyelitis—pyelo-nephritis (Rayer).) This is usually found in conjunction with that form of acute pyelitis in which the pelvis of the kidney is filled with putrid urine, pus, and mucus, but is by no means constantly so. In one case which was observed at University College Hospital, both kidneys were equally riddled with abscesses, but in one the pelvis was acutely inflamed and filled with foul urine, while in the other it was free from disease, and the urine it contained acid, and without unpleasant smell. The kidney is generally swollen and enlarged. The fat surrounding it is usually abnormally adherent to the capsule. The capsule is thick and opaque, and marked by ramiform vessels, showing clearly on the surface. It separates easily, but in so doing tears the kidney-substance. The surface of the kidney presents a more or less mottled appearance. The chief tint is the same as in the diffuse form just described, and is, in fact, due to the existence of the same condition; but here and there, scattered usually in groups, are bright yellow spots, surrounded by a dark red areola, and varying in size from a pin's head to a split pea. On cutting into these yellow spots, each is found to contain a drop of pus. These minute abscesses are usually grouped in areas corresponding to that part of the cortex which belongs to a single pyramid. If now a section be made of the kidney, the points of suppuration will not be found to be limited to the surface. Often they are continued down towards a pyramid, and are connected with a yellow streak running parallel to the straight tubules as far as the papilla, or, if that have been partly destroyed by pressure, as far as the point at which the tubules open into the pelvis. This condition is not invariable, as sometimes the abscesses are perfectly isolated, and show no connection whatever with the pyramidal portion of the kidney. Occasionally one or more of the abscesses may burst beneath the capsule, separating it from the kidney, and giving rise to further suppura-

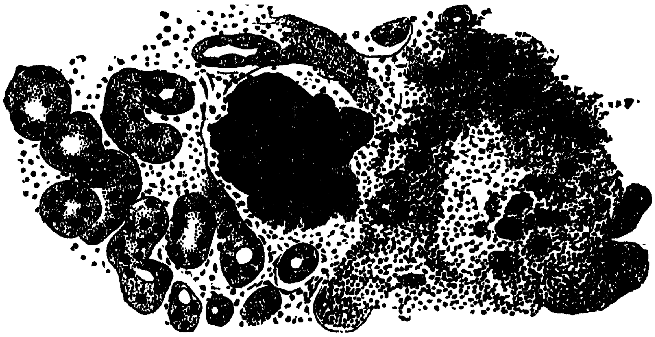


Fig. 708. Acute Interstitial Nephritis: Scattered Abscesses. Margin of abscess to the right. Malpighian body in the middle. Comparatively healthy tubules with inter-tubular cell infiltration, to the left.

tion, may include the whole organ in a large collection of pus. The microscope shows that in this form of kidney the appearances are essentially the same as in the last; the chief change being the accumulation of crowds of small round cells in the intertubular substance, the degree of cell-infiltration varying in almost every field of the microscope. At the point at which an abscess is forming, or at the margin of one already formed, the crowds of small round cells are seen to press upon the tubules, separating them widely, and squeezing their walls together. Then the wall becomes indistinct; then only a few epithelium-cells can be recognised in the crowd of leucocytes; lastly, nothing but leucocytes can be seen, and a little nearer the centre the intercellular substance becomes fluid, and the cells float free, and pus is so formed. The red areola is not found to be due to extravasation, although hæmorrhages may exist scattered through such a kidney. The yellow streaks in the pyramids are found to be due to a similar condition of intertubular cell-infiltration. Sometimes clots may be seen in the vessels of the pyramids. These are probably secondary to the inflammation of the parts surrounding the vessels. As in the former variety, small round cells may be found in the tubules as well as outside them. The epithelium is usually much swollen, and sometimes desquamating and choking the tubules, but this is only in those areas in which the interstitial inflammation is most advanced. In others it may appear almost healthy. This form of kidney merges into the diffuse variety, the solid yellowish spots before mentioned representing points which, had the patient lived longer, might have softened into abscesses. It is of course frequently conjoined with the signs of pressure, absorption of the pyramids, and dilatation of the pelvis. It is perhaps the most frequent form met with in the *post mortem* room. The abscesses of the kidney thus arising from acute suppurative nephritis must not be confounded with those seen as the result of the lodgment of septic embola in pyæmia. These are usually larger, are more distinctly wedge-shaped, and sometimes surrounded by a zone of hæmorrhage. They are always in the cortex, and the pyramids show no signs of disease.

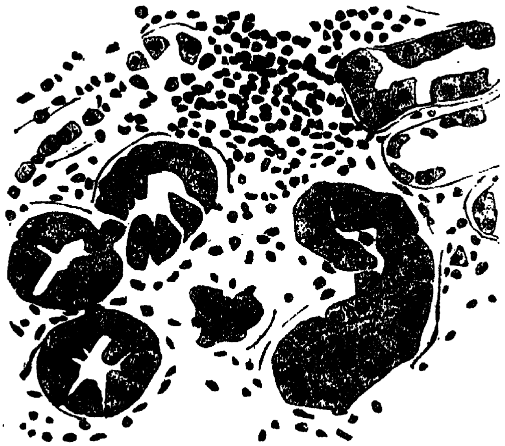


Fig. 709.—Acute Interstitial Nephritis: Condition of Epithelium.

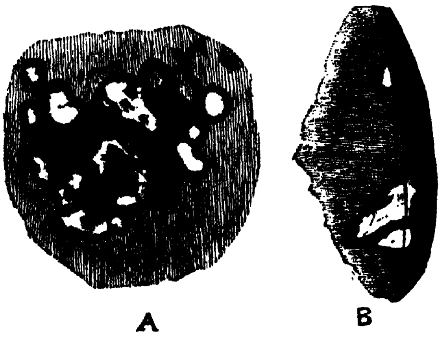


Fig. 710.—A. Group of Abscesses on Surface of Kidney. B. Vertical Section of the same.

Pyelitis is absent, but, as before stated, it may be wanting also in cases of interstitial inflammation. The microscope shows an absence of the general changes noticed above, and if an early stage of a pyæmic abscess can be detected, hæmorrhage will be found in the midst of comparatively healthy kidney-tissue, whilst the earliest stage of suppurative nephritis is characterised by acute cell-infiltration.

3. *Effects of Former Attacks from which the Patient has Recovered.*—It is possible that the kidney may undergo extensive intertubular change, and yet, if the cause be removed, the inflammatory growth may be completely absorbed, and the organ regain its normal condition. More commonly, however, the new growth undergoes a development into fibrous tissue, a change corresponding exactly to that which occurs in the cicatrisation of a granulating sore, and accompanied by a similar process of contraction. Thus we get an increase in the intertubular connective tissue, and at the same time a contraction and induration of the whole organ, so much so that it is sometimes reduced to less than a quarter of its normal bulk. If the pyramidal portion have undergone absorption, this is never repaired, but, as its function seems merely that of a duct, its loss is of no great moment. In a kidney of this kind we find the fat adherent to the capsule, and the capsule to the gland-tissue. It strips off with difficulty, and is thick and opaque. The surface of the kidney is irregular, granular, or perhaps even puckered by cicatrices. Scattered over the surface in most cases are numerous small cysts. These are supposed to be due to the strangulation of the tubules by the fibrous growth. The colour is usually dark and somewhat red, with numerous small dilated veins showing on the surface. On section, the cortex will be found to be greatly thinned, being sometimes not thicker than a shilling. The pyramids, unless absorbed from previous pressure, are but little altered. The whole organ is of a leathery toughness which is quite peculiar. The pelvis may be pigmented from previous inflammation. The microscope shows a great increase of the intertubular tissue, which is of a dense fibroid character. The tubules vary in size ; some are strangulated and compressed, others are dilated above the strangulation. Many of the Malpighian corpuscles are obliterated, leaving merely capsules containing the remains of the obliterated vessels. The capsules of all the Malpighian bodies are greatly thickened. The epithelium may be flattened by pressure, or normal. The small arteries usually show some hypertrophy of their muscular coats. Such a kidney as this may undergo a second attack of acute inflammation, and we then find a combination of the form of the contracted kidney with the colour and softness, and possibly the scattered abscesses, of the acute variety. It will be seen from the above description that this form of kidney differs in no way to the naked eye from the ordinary granular, contracted, or gouty kidney. We do not, however, find the general changes associated with that disease. In a case which lately occurred at University College Hospital, in which this condition was well marked as the result of stricture of the urethra, there was no hypertrophy of the heart, and no change could be recognised in the walls of the small vessels in other parts.

From what has been said, it is evident that the inflammation of the kidney arising as the consequence of diseases of the lower urinary tract is primarily interstitial in character, the changes in the epithelium being secondary.

**Causes of Interstitial Inflammation.**—The following may be stated as the causes which in varying degree take part in the production of interstitial inflammation of the kidney: 1. Tension; 2. Reflex irritation of the kidney; 3. The presence of septic matter in the pelvis of the kidney. Each of these acting singly may induce serious disease, or perhaps even cause death, but we seldom see such cases. More often, two at least are in action.

1. *Tension.*—It has been shown before how this is induced by any obstruction to the free entrance of urine into the bladder. Every practical Surgeon is acquainted with the fact that tension is one of the most powerful irritants to which the living tissues can be exposed. The examples of a tight stitch, pent up pus, and mammary abscess from obstruction to a duct, must occur to everyone. In the analogous case of the mamma, the inflammation resulting from obstruction affects the interacinous cellular tissue, which becomes infiltrated with small cells. In the liver, Wickham Legg and others have shown that ligature of the bile-duct causes interstitial hepatitis. In the kidney, no recorded case is to be found of suppuration occurring as the result of simple tension; but in all cases in which evidence of tension exists, that is to say, dilated ureter or pelvis of the kidney, or some source of sudden obstruction as a more or less impacted calculus, subacute interstitial inflammation will be found. It seems almost as if the new cell-growth were a conservative change intended to strengthen the tubules to resist the increased pressure. However this may be, a kidney in this condition is in a state in which a little further irritation from any cause may hurry it on to fatal and acute inflammation.

2. *Reflex Irritation of the Kidney.*—Mechanical injuries to the neck of the bladder or posterior part of the urethra, and probably diseases of these parts in which constantly recurring irritation is present, re-act upon the kidney through the influence of the nervous system. It is needless here to attempt any explanation of the exact manner in which this takes place, as it would be merely a matter of speculation; but a few facts may be given as proof of the assertion. It is well known that several cases are on record, in which death has occurred from suppression of urine following the simple introduction of a catheter, the *post mortem* examination showing a condition of intense congestion of the kidney. Again, patients with stone in the bladder occasionally die from acute inflammation of the kidney, often accompanied by suppuration, after the operation of lithotrity. Cases of this kind have occurred in which the cystitis was not increased by the operation, in which the decomposition of urine remained unchanged, and no altered circumstance existed, except the mechanical injury of the passage of the instrument, to account for the sudden supervention of acute nephritis. In these cases signs of chronic disease, which has been rendered acute by the additional irritation, are always present. Lastly, a few cases have been observed at University College Hospital after operations for stricture, with the view of ascertaining if any change could be found in the urine as the direct result of the operation. In three cases of Holt's dilatation, the urine was found to be free from blood, or to contain no more than could be accounted for by the operation, during the first hour or hour and a half after the operation, and then to become gradually more and more bloody for another hour or hour and a half, and after that to become gradually free from blood.

In one case there was almost total suppression for the first hour and a half, followed by very bloody urine. In one case of internal urethrotomy, during the first hour the urine flowed away in great quantities, and was almost free from blood. For the next six hours it was passed in moderate quantity, and was very darkly tinged with blood. In all four cases, there was some reason to believe that the blood came from the kidney. It occurred after the hæmorrhage from the wound would have ceased; it was uniformly mixed with the urine, and free from clots. These cases are of course insufficient in number to draw any conclusions from them; but, as far as they go, they tend to show that, in all cases of operation on the urethra, there is a miniature representation of that intense congestion of the kidney which is found in cases of death from suppression of urine after simple catheterism. Possibly in some cases the dilatation of the vessels is preceded by a contraction of longer or shorter duration, giving rise to the suppression noted above. In a healthy kidney such an attack of acute hyperæmia soon passes off and does no harm; but, supposing the kidney to be already diseased, the subacute condition may readily become acute and terminate fatally. Repeated attacks of such hyperæmia, which probably result from the irritation of a stone, or passing urine through a bad stricture, would in all probability be alone sufficient to lead to a chronic interstitial change in the kidney. It is a matter of observation, that fatal affections of the kidney scarcely ever result from operations performed on the penile portion of the urethra.

3. *The presence of Septic Matter in the Pelvis of the Kidney.* This plays a most important part in producing the final acute condition which often kills the patient. In the first place, the mere presence of such an irritating substance as ammoniacal urine in the pelvis of a kidney already diseased, would certainly intensify the existing inflammation. It seems probable, however, that in many cases the septic matter thus pent up at some degree of pressure (for the thick mixture of mucus, pus, and urine cannot pass the valves of the ureter already somewhat obstructed by the swollen mucous membrane, and perhaps by a hypertrophied or distended bladder, so readily as healthy urine) becomes absorbed by the lymphatics of the kidney, and thus gives rise to a diffuse intertubular inflammation rapidly running on to suppuration. This would account for the pale streaks seen running in many cases parallel to the straight tubules in the pyramids, and expanding in the cortex. Probably this condition alone is sufficient to account for many cases of acute suppurative nephritis, but it must be remembered that suppuration of the kidney does occur, not unfrequently, in cases in which the urine in the pelvis is free from decomposition. Dr. George Johnson suggests that the scattered abscesses may occasionally be due to rupture of the tubules and local extravasations of urine; and in a kidney already softened by acute interstitial nephritis, it is very possible that this may occur. Dr. Dickinson accounts for the abscesses by a theory of septic embolism in the veins, a sort of local pyæmia; but the presence of the general change, and the fact that every stage is found between commencing diffuse interstitial inflammation and the fully formed abscesses, seem to contradict this view. Goodhart of Guy's Hospital has suggested the possible connection between erysipelas and suppuration of the kidney, and has advanced some very interesting evidence in favour of his view,

which is well worthy of further investigation, although, at most, it could but account for a small proportion of the deaths from this disease.

It will be seen from the above, that in the production of fatal interstitial nephritis a number of causes are at work, sometimes all together, sometimes singly, and no exclusive theory can possibly explain more than a small proportion of the cases.

**Symptoms of Kidney-Disease in Surgical Affections of the Genito-Urinary Organs.**—*Simple dilatation of the kidney*, although a condition seriously endangering the success of any operation on the urinary organs, gives rise to remarkably few symptoms ; and it is surprising to what an extent the structure of the kidney may be damaged by chronic interstitial nephritis arising from this cause without interfering in any noticeable degree with the patient's health. It gives rise to no œdema, no marked anæmia, and no alteration in the function of the skin. The most characteristic feature is probably an increase in the quantity of urine, with a diminution in the specific gravity. In a case lately in University College Hospital, the patient passed five pints of urine daily of a specific gravity of 1003 or 1004. In all cases in which it is desirable to ascertain the condition of the kidneys, the urine should be collected for the whole day, and the specific gravity taken. If the quantity be large and the specific gravity low, chronic interstitial nephritis may be suspected. The quantity of albumen is always small, and it may be absent altogether. At most, only a few hyaline casts can be found, and often no renal epithelium. The excretion of urea is usually in sufficient amount, as the quantity of urine makes up for the low specific gravity. If the primary disease give rise to much pus and mucus, or to a little blood, the difficulties of diagnosis are greatly increased, and reliance must then be placed solely in the quantity and specific gravity, and even these may prove deceptive. It is rarely possible to gain much information by feeling the kidney. There is no tenderness, and it is seldom sufficiently enlarged for the Surgeon to form any conclusion as to its condition.

*Subacute interstitial nephritis* gives rise to more evident symptoms. The patient is weak and languid, and slowly but steadily emaciates. He loses his appetite and has occasional attacks of nausea, though rarely actual vomiting. His tongue is furred and has a tendency to become dry, and occasionally there is thirst. There is no tenderness over the kidney. There may be occasionally a slight feeling of chilliness, seldom actual rigors. The temperature will be found to be slightly elevated, especially at night; and for this reason, in any doubtful case, it is essential to obtain the evening temperature, as in the morning it may fall to normal. It seldom rises above 101° F. The urine is abundant and usually of low specific gravity, but by no means always so. It is seldom possible to find casts or to judge of the amount of albumen, as this form of disease usually accompanies bladder-affections, which fill the urine with pus or mucus, as chronic cystitis, stone, and stricture. At most, only a few renal epithelium-cells and possibly a hyaline cast or two could be found. This condition may last for weeks or even months, the patient gradually becoming weaker and weaker until he is carried off by some intercurrent disease, or dies of pure exhaustion. More commonly, however, an acute attack supervenes on the subacute, either spontaneously or as the result of some surgical interference, and, rapidly ending in suppuration of the kidney, terminates fatally. On the other hand, the symptoms often gradually subside, the temperature becomes normal, and the patient gains strength. The improvement usually coincides with some diminution of the local irritation at the primary seat of disease, such as results from rest in bed in a case of stone, or from the cleansing of a foul bladder. As the symptoms are somewhat indefinite, it is often difficult to say how much is due to renal mischief and how much to the primary affection ; but wherever we find a dry tongue, a persistent nocturnal elevation of temperature, loss of appetite, general weakness and emaciation, we ought to make every attempt to get rid of these symptoms before undertaking any serious surgical procedure, such as the treatment of stricture, lithotomy, or lithotrity, the irritation of which might start the smouldering inflammation into activity.

*Acute interstitial and suppurative nephritis* gives rise to much more manifest symptoms, often supervening on those just described. The attack, which is often induced by some surgical procedure although it may commence spontaneously, begins with a severe rigor, followed by profuse sweating. The temperature may rise to 105° F. or 106° F. After the rigor it falls, but remains somewhat above normal. The rigors and sweating may be repeated more than once. The tongue rapidly becomes dry, red, and fissured, looking like a piece of broiled ham, and sordes accumulate on the teeth. There are complete loss of appetite, and rapid emaciation ; nausea is almost a constant symptom, and actual vomiting is common. Diarrhœa may occur. The patient soon sinks into a heavy drowsy state, often with contracted pupils, so that the condition may closely resemble that of opium-poisoning. He can be roused and answers rationally if spoken to, and in most cases complains of little pain or discomfort. The temperature now usually falls, sometimes below normal, and the skin feels cold and clammy. In this form, there is usually some tenderness on pressing firmly in the region of the kidneys. As the case progresses, muttering delirium sets in, followed by more complete insensibility, but it rarely reaches a condition of absolute coma. Convulsions are extremely rare. There is no œdema at any time. The urine varies much. It usually becomes more or less bloody, and in rare cases is suppressed ; though much more frequently a considerable quantity is passed up to the time of death. It is usually in such a state from decomposition and the presence of pus, blood, and mucus, as to render accurate chemical and microscopical investigation impossible. Pus-cells are constantly present, but whether they come from the kidney or the bladder in any particular case cannot be ascertained, unless they are found, as in rare cases they are, in the form of pus-casts. In some anomalous cases, diarrhœa forms a very prominent symptom. In one case that occurred in University College Hospital, the stools exactly resembled those of typhoid fever ; and the *post mortem* examination, in addition to suppuration of the kidney, showed ulceration of the lower part of the small intestine.

Malherbe, who has written an admirable treatise on uræmic fever, describes a form of this disease in which secondary abscesses appear in various parts, the contents of which have an urinous odour. It is doubtful if this is not in reality a form of pyæmia.

The duration of an acute attack as above described, when terminating fatally, varies from a few days to a couple of weeks. In favourable cases, even after very marked symptoms, such as the rigors, dry tongue, vomiting, and diarrhœa, the patient may slowly recover. The cause of death in many cases seems to be septicæmia from absorption of the septic matter from the kidney rather than uræmia. Certainly the mode of death differs greatly from that of acute Bright's disease, the profound coma and convulsions being rarely present.

The *Diagnosis* has to be made from pyæmia, peritonitis, typhoid fever, and ague. From pyæmia the diagnosis is somewhat difficult, the most important points being the vomiting, the absence of secondary abscesses, the drowsy state into which the patient soon falls, and the fact that the temperature often remains for days before death, below normal. The vomiting and extreme illness may resemble the low, diffuse, painless form of peritonitis sometimes seen in affections of the bladder, but the vomiting has not the pumping character of that in peritonitis, and the elevation of temperature for the first few days is unlike that form of peritonitis in which the temperature is persistently low. Suppurating kidney can only resemble typhoid fever in rare cases, and the absence of spots, and the temperature will usually serve to distinguish them. In the case above mentioned, the temperature was below normal for three weeks before death. From ague, the disease is diagnosed by the absence of the complete intermission after the sweating stage; but it must be always remembered that patients who have suffered from ague are singularly liable to attacks of fever after any operation on the urinary organs.

**Urethral Fever or Uræmic Fever.**—This term has been somewhat loosely used to signify a rigor followed by sweating, and more or less prolonged elevation of temperature, consequent on some operation on the urinary organs, or possibly arising spontaneously. It will be seen at once that this definition includes acute interstitial nephritis, as above described, and also pyæmia. When a patient has been said to have died of "urethral fever," one of these two conditions has been invariably found, although no Surgeon would intentionally include pyæmia under urethral fever. It is probable that the real nature of the affection is, at least in the great majority of cases, a disturbance of the circulation in the kidney, or some interference with its function, due to reflex irritation from the passage of the instrument, as before described in speaking of the sources of irritation to the kidney. That it is not due to absorption of urine from a wound in the urinary passages, is evident from the fact that rigors are rare after lithotomy, and are not a marked symptom of extravasation of urine, and that wounds of the urethra anterior to the scrotum scarcely ever give rise to them. This view of the renal origin of so-called urethral fever is supported by Malherbe, in his treatise on Uræmic Fever, as he would call it. It is difficult to obtain direct proof, but further knowledge might be gained by carefully examining hour by hour the quantity and quality of the urine secreted after any urethral or vesical operation, and at the same time accurately observing the changes in temperature, even when the rigor does not occur. Malherbe states that the temperature rises in almost every case; and in one of the four cases of stricture mentioned before, the temperature rose to 100·3° F. about three hours after the operation, when the urine became bloody. It fell to 99·2° F. when the blood disappeared; but three hours afterwards a little more blood showed itself, and the temperature again rose to 100·3° F. Further investigation in the same line might lead to some important results.

**Prognosis.**—The prognosis in acute affections of the kidney, secondary to bladder disease, is always grave ; but even the most unpromising cases may recover. Vomiting, delirium, partial insensibility, and a very dry tongue, are all bad signs. A marked diminution of the quantity, and much blood in the urine, are unfavourable symptoms.

**Treatment.**—Prevention is of course first to be aimed at. No patient should therefore be submitted to an operation except in cases of necessity, without a careful examination of the whole day's urine as to specific gravity, the presence and quantity of albumen, and the microscopic appearances. If possible, the temperature should be observed night and morning for two or three days. If any suspicion arise as to the condition of the kidneys, that operation should be selected, when practicable, which gives rise to least irritation. Soft instruments should be employed instead of metal, and a sufficient interval allowed between their use. Above all, any treatment calculated to cause cystitis, or to give rise to decomposition of the urine, should be avoided. As there can be but little doubt that the causes of decomposition are often introduced into the bladder by catheters or other instruments, these should be kept scrupulously clean. Some recommend oiling the instruments with carbolic acid and oil (1 to 10). If decomposition already exist in the urine, it should if possible be arrested by washing out the bladder with some antiseptic, for which purpose quinine and diluted sulphuric acid, in the proportion of gr. ij. and m. ij. to an ounce of water, will be found very efficacious. If the cause of the renal mischief be stricture of the urethra or stone, some operation must of course be undertaken ; but if the temperature be elevated, or there be other signs of renal disease, it should be delayed until an attempt has been made by rest and other remedies to bring the kidneys into a healthy state. If after a few days no improvement be seen, and it seem probable that the disease is kept up by the presence of the stone or stricture, further delay is useless ; and, choosing the least severe and irritating operation, the Surgeon must operate at once.

The treatment of well-marked interstitial nephritis is extremely unsatisfactory. If there be any tenderness in the loins, dry cupping may be of service. The bowels should be well acted on by purgatives, and the skin by hot-air baths, to relieve the kidneys as much as possible. Heroic operations undertaken during acute nephritis in the hope of removing the cause, are almost always, if not invariably, fatal. Quinine and opium have been recommended for the prevention of the rigors that frequently follow operations on the urinary organs. Opium is probably of service, but must be given with great caution if any symptoms of uræmic poisoning exist ; but quinine has not, according to most who have tried it, proved of any use. Diet and stimulation must be regulated on general principles.

# CHAPTER LXVIII.

## URINARY CALCULUS AND LITHOTOMY.

### CALCULOUS DIATHESES AND DEPOSITS.

The urine is liable to the deposit of various solid matters, which, when amorphous and impalpable, are termed **Sediments**; when crystalline, they constitute **Gravel**; and when concrete, **Calculus** or **Stone**. These deposits, whatever form they assume, are the result of constitutional causes; and the constitutional conditions giving rise to them are commonly called **Diatheses**. Of these, Surgeons usually recognise three: the *Uric* or *Lithic*, the *Oxalic*, and the *Phosphatic*; besides, these, however, others doubtless exist, the precise characters of which have yet to be determined.

**Uric or Lithic Acid Diathesis.**—This diathesis chiefly occurs in individuals of robust habit of body and florid appearance, who have lived high, and suffer from irritable gastric dyspepsia. It is often associated with a gouty or rheumatic tendency, or with some of the more chronic forms of skin disease, especially psoriasis. It is characterised by scanty and acid high-coloured urine, which deposits on cooling two kinds of sediment, a yellow and a red. According to Lehmann, these sediments consist of urate of soda: but Golding Bird, and, I believe, most of the chemists in this country, regard them as urate or lithate of ammonia. But W. Roberts states that they have no definite chemical composition, consisting of uric acid combined with soda, potass, and ammonia, in varying proportions. The yellow sediment, containing an admixture of the colouring matter of the urine, is usually dependent on slight disorder of the digestive organs and skin, coming and going under the influence of very trivial causes. The red sediment, owing its colour, according to Bird, to an admixture of purpurine, a highly carbonaceous ingredient, and indicative of imperfect assimilation, is met with in persons of full habit, who live too freely.

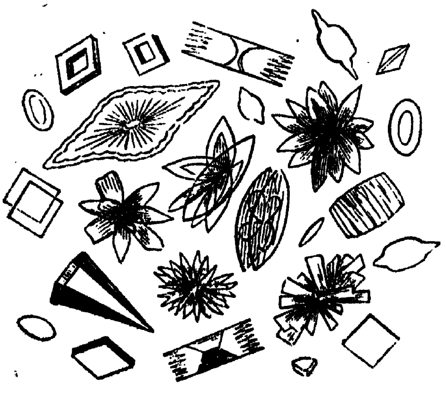


Fig. 711.—Uric Acid.

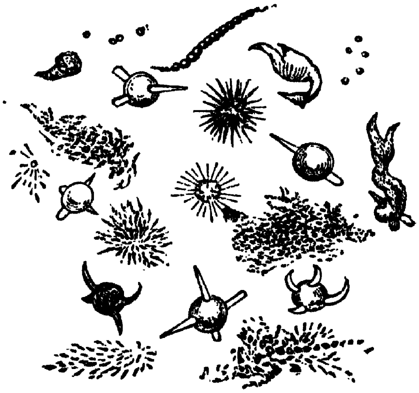


Fig. 712.—Urate of Ammonia.

A variety or rather an admixture, of these sediments, constitutes the *lateritious deposit,* so common in gout and rheumatism. These deposits disappear completely on boiling, which distinguishes them from any other sediments. The red sand or gravel is a crystallised variety of the lithic acid sediment. It may be compared, in general appearance, to Cayenne pepper, and under the microscope presents the characters seen in Fig. 711. It is not unfrequently met with in children of a strumous habit, who are allowed more animal food than they can well assimilate. Occasionally crystals of uric acid are found intermixed with these deposits, presenting the characters figured in Fig. 712.

*Calculi.*—The calculi that occur in this diathesis are of two kinds; the uric acid, and the urate of ammonia. The uric acid calculus (Fig. 713) is usually of small or moderate size, varying from a pin's head to a pigeon's egg; it is oval, somewhat compressed and flattened, smooth on the surface, and of a fawn colour. On section it is seen to be laminated, and to present various shades of a light brown or fawn tint. The urate of ammonia calculus is of very rare occurrence; when met with, it is chiefly in children, and is composed of concentric rings, having a fine earthy appearance, and being clay-coloured. The uric acid calculus may be distinguished from the urate of ammonia by heating a fragment in solution of caustic potash: both dissolve, but the urate of ammonia evolves ammonia in the process of solution.

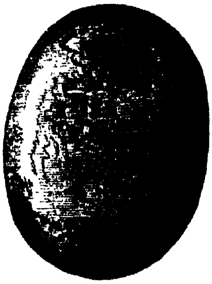


Fig. 713.—Uric Acid Calculus.

*Treatment.*—The treatment of the uric acid diathesis must be directed to the removal of the prime causes of this condition, viz., mal-assimilation, defective oxygenation of the blood, and the ingestion of too large a quantity of stimulating food. All these may be remedied by attention to ordinary hygienic measures; the patient must live sparely, should avoid fermented liquors, especially red and effervescent wines, and abstain from sweets, pastry, &c. He should take plenty of out-door exercise, and keep the skin in healthy action by warm dry air or vapour bathing, and the use of horsehair gloves. The bowels must also be carefully regulated by means of saline and other aperients, with occasional alterative doses of blue pill; to which, if the constitution be peculiarly rheumatic or gouty, some colchicum may advantageously be added. Preferable to all medicines, perhaps, are the natural aperient saline waters of Püllna, Friedrichshall, or Carlsbad, taken fasting. The patient may also be directed to drink some of the natural alkaline waters, as those of Vichy, Vals, or Fachingen. The Vichy waters, containing a large quantity of carbonate of soda, with free carbonic acid, are extremely serviceable for the correction of this diathesis. If they cannot be procured, a very good alkaline drink consists of a scruple of bicarbonate of potass and five grains of nitre dissolved in a tumbler of cold or tepid water, to which about five grains of citric acid or a tablespoonful of lemon-juice may be added, and taken early in the morning or in the middle of the day. The preparations of lithia are of essential service in removing uric acid gravel or in clearing the urine of urates. They may be given alone, or in combination with the citrate or carbonate of potass.

When uric acid calculus has actually formed, it is well not to give the alkaline remedies too long, or in too large quantity; lest the stone rapidly increase in size by becoming encrusted with phosphates.

**Oxalic Diathesis.**—This is characterised by the formation of oxalate of lime in the urine. It generally occurs in individuals in whom there is defective assimilation, dependent upon exhausted nervous energy, arising from over-work, mental anxiety, or venereal excesses. The patient is usually pale and hypochondriacal, suffers from dyspepsia, acidity of stomach, and disturbed sleep. In these cases there is often loss of sexual power; a state of debility of the generative organs, connected either with the want of erectile vigour, or too speedy emissions. The urine is usually very pale, abundant, and acid, and there is heat and smarting during its passage along the urethra. In this diathesis there is no sediment or gravel, properly speaking, but the crystals float in the urine; subsiding, however, when it stands, but not occurring in sufficient quantity to constitute a true sediment (Fig. 714). Roberts states that oxaluria accompanies no constant state of symptoms, and questions the existence of such a diathesis; so much so, as to state that the presence of oxaluria by itself furnishes no indication for treatment.

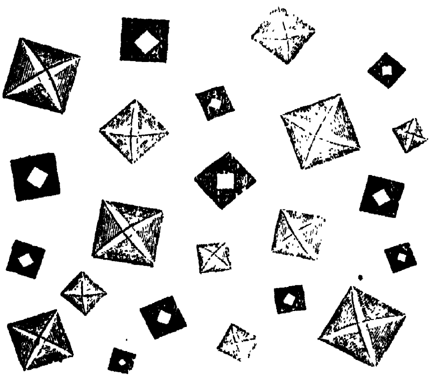


Fig. 714.—Crystals of Oxalate of Lime.

**Calculus.**—The oxalate of lime or mulberry calculus is usually of a dark-brown or almost black colour, moderate in size, being seldom larger than a walnut, and round; it is always rough, tuberculated, and sometimes almost spiculated on the surface (Fig. 715).

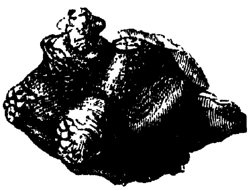


Fig. 715.—Very rough Oxalate of Lime Calculus.

*Treatment.*—When there is no calculus, it is necessary to put the patient upon a light and nourishing diet, especially fish, as recommended by Bird, cautioning him to avoid sweets and all fermented liquors, with the exception of a moderate quantity of brandy. Tonics, particularly the mineral acids, iron, zinc, and quinine, may be given, and the residence should, if possible, be changed for a time to a warm climate. When calculus is formed, there is, owing to its roughness, and the irritable state of the patient's nervous system, usually a good deal of pain in the region of the bladder, requiring the free administration of opiates.

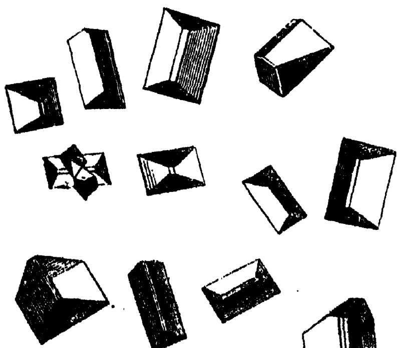


Fig. 716.—Crystals of Ammoniaco-Magnesian Phosphate.

**Phosphatic Diathesis.**—This chiefly occurs in old persons, or in those who are prematurely aged, with a broken constitution and an anæmic condition of the system. In this diathesis, the sediment and calculi may occur in three distinct forms: 1. Triple or Ammoniaco-Magnesian Phosphate; 2. Phosphate of Lime; and 3. Mixed Phosphates, consisting of a mixture of the preceding varieties.

1. The *Triple Phosphate* (Fig. 716) usually occurs in urine that is copious, pale, and barely acid, sickly to the smell, and soon decomposing and becoming very offensive. In other cases the urine is dark, alkaline, and mucous. This condition especially occurs in old people, and is associated with much debility, irritability of mind, pallor, and anæmia.

2. The *Phosphate of Lime* sediment is of less common occurrence; it usually occurs in pale and offensive, readily putrescent urine, mixed with much mucus, and in some cases apparently produced by the mucous membrane of the bladder.

3. *Mixed Phosphates* commonly occur after injuries of the spine, as the result of general impairment of the health, or in advanced cases of prostatic disease. They are occasionally met with in large quantity, forming a kind of mortar-like sediment in the bladder. They are deposited whenever the urine from any cause becomes alkaline from decomposition.

**Calculi.**—The phosphatic calculi are very common. The most frequent is the mixed, or fusible calculus, as it is termed, on account of the ready way in which it melts when exposed to heat. This calculus is friable, laminated, and has a chalky or earthy look. The calculus composed of phosphate of ammonia and magnesia is not so common; it resembles the preceding rather closely in its general characters, but is whiter and has a more chalky look. The phosphate of lime calculus is extremely rare; it is laminated, and harder than the other varieties.

*Treatment.*—The treatment of the phosphatic diathesis consists principally in improving the digestive powers, and in restoring the general strength of the patient by giving him good food, wine, or beer. The administration of tonics, especially of nitric acid, should be attended to, and exercise in the open air enjoined. As there are usually much pain and irritability of system in this diathesis, opium may advantageously be administered. Roberts considers phosphates in the great majority of cases as merely the result of the alkalinity of the urine, from whatever cause arising.

Besides the calculi mentioned, various other kinds of concretions form in the urine, each of which doubtless represents a diathesis; the characters of which, however, are not so distinctly marked or so well recognised as those that have just been described.

**Cystine** is one of the rarer forms of morbid product occasionally met with in the bladder. It differs from all other ingredients in containing a large quantity—about 26 per cent.—of sulphur. It is very rarely seen as a sediment in the urine; but when it occurs in this form it presents the microscopic characters seen in Fig. 717, being composed of hexagonal laminæ. Calculi containing cystine have occasionally been met with. Golding Bird states that in Guy's Hospital Museum there are eleven composed of this peculiar animal matter; and in the Museum of University College we have some good specimens. Cystine in calculus has a peculiar yellowish or greenish and waxy look, very different from any other ingredient met with in urinary concretions.

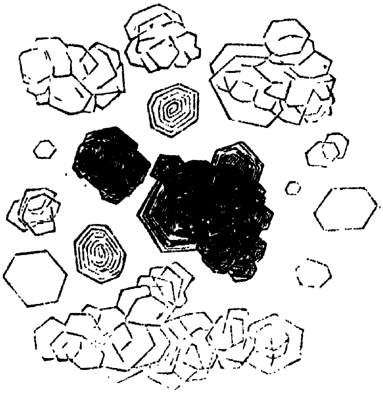


Fig. 717.—Crystals of Cystine.

**Xanthine**, or **Xanthic Oxide**, was first noticed by Marcet, and has since been observed by Laugier, Langenbeck, and others. It is of extremely rare occurrence, and has only been found in four recorded instances in the form of calculous concretions. These have generally been of small size, with the exception of the one removed by Langenbeck, which weighed 388 grains. For a detailed account of the chemical characters and constituents of this substance, as well as of the other materials of which calculi are formed, I must refer to the works of G. Bird, Beale, Thudichum, &c.

**Carbonate of Lime** has occasionally been met with as an amorphous powder in alkaline or very faintly acid urine. Bird states that he has detected carbonate of lime as forming a distinct stratum in some phosphatic calculi; and Thudichum has examined prostatic concretions consisting almost entirely of this substance—the urinary origin of which, however, he doubts. But urinary vesical calculi composed of carbonate of lime are certainly very rarely met with.

### STONE IN THE BLADDER.

STRUCTURE OF CALCULI.—Calculi, though sometimes composed throughout of the same deposit, are not unfrequently made up of layers or strata, differing in chemical composition from one another, and these usually go by the name of *alternating calculi* (Fig. 718). Most frequently the nucleus consists of lithic acid; next in the order of frequency comes the oxalate of lime; and then the concretion of a phosphatic character throughout. It is very seldom that the nucleus is absent; but concretions have occasionally been met with in which none could be detected, or in which it was even replaced by a cavity. The nucleus is usually as nearly as possible in the centre of the calculus, and is generally nearly regular in shape; occasionally, however, it is branched or curiously radiated, and then the concretion generally affects a corresponding outline. Calculi containing two or three nuclei have sometimes been found, consisting probably of an equal number of concretions agglomerated together. A foreign body occasionally takes the place of a nucleus.

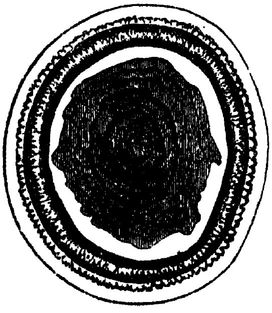


Fig. 718.- Section of an Alternating Calculus.

The body of a calculus having the uric acid nucleus is usually composed of some of the lithates; but not unfrequently these are incrusted by a deposit of phosphates. In other instances, the body may be wholly composed of some of the earthy phosphates, which more rarely alternate with the oxalate of lime or the triple phosphates.

An oxalate of lime nucleus usually has a body of the same constitution; but in some cases it is incrusted by phosphates or urates (Fig. 719). When the interior is phosphatic, the concretion is always of the same constitution.

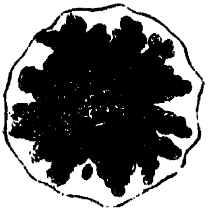


Fig. 719.—Section of Oxalate of Lime Calculus incrusted with Phosphates.

The alterations in the composition of a calculus are due to varying conditions of the general health, and consequently of the character and constituents of the urine, and of the state of the lining membrane of the bladder. The uric acid and oxalate of lime nuclei and layers are undoubtedly due to constitutional causes. The phosphatic laminæ, whether interposed between the uric acid or incrusting the calculus, are probably chiefly dependent on vesical irritation and decomposition of the urine, consequent on the presence in the bladder of the uric acid or oxalate of lime nucleus which has been previously formed.

ORIGIN.—Calculi may be formed either in the kidneys or in the bladder. Those that contain nuclei of the urates or oxalates are probably renal in their origin; whilst those that have a phosphatic nucleus are usually vesical from the first; renal nuclei of this composition being rarely met with.

All renal calculi, all those vesical calculi that have a renal origin, and some of those even that appear to be primarily formed in the bladder, have a constitutional source; they arise from a morbid state of the urine, which probably in its turn depends upon mal-assimilation, the peculiar form of which determines the chemical composition of the stone. Those calculi that are formed by deposit from the urine upon and around some foreign body, as a pin or straw accidentally introduced into the bladder, and some soft phosphatic concretions that appear to be the result of an unhealthy state of its mucous membrane, may be looked upon as being local in their origin.

**Calculi of Renal Origin.**—When a stone forms in the pelvis of the kidney, it usually gives rise to pain in the loin. When of small size, it may descend into the bladder with but little suffering to the patient; but, if large enough to irritate the ureter and to pass with some difficulty, it then gives rise to a peculiar train of symptoms, which will immediately be described. In some cases the calculus attains a very large size, occupying the whole of the pelvis of the kidney, extending into the calices and ureter, and being moulded, as it were, to the shape of the parts amongst which it lies; it then gives rise, by its pressure, to absorption of the substance of the kidney, and occasions, by the magnitude that it attains, excessive pain and irritation in this region, the patient usually dying, worn out by constant suffering and by the irritation of incurable kidney-disease. In some instances, stone in this situation has given rise to abscess in and around the kidney, and has even been discharged through an aperture in the lumbar region.

*Descent of a Renal Calculus.*—In cases in which a renal calculus descends into the bladder, the patient is seized with pain in the loin that has been the seat of previous irritation. This pain is usually of the most agonising character, extending into the spermatic cord and testis, and down the inside of the thigh of the affected side. There is retraction of the testicle, with constipation and vomiting; frequently accompanied by the passage of scanty, high-coloured, and bloody urine, and great constitutional disturbance. This pain usually continues of a somewhat remittent character, until the calculus enters the bladder, when, unless expelled, it gives rise to the train of symptoms peculiar to its presence in that organ.

*Treatment.*—During the descent of a renal calculus, which always occupies many hours, and perhaps some days, the patient should have full doses of opium administered, drink freely of bland diluents, be put into a warm hip-bath, and have hot fomentations or mustard poultices applied to the loin; the bowels should also be thoroughly emptied by enemata. It is well to bear in mind, that a somewhat similar train of symptoms to that induced by the descent of the calculus, may be excited by some forms of irritation or flatulent distension of the cæcum and descending colon, which will require appropriate treatment.

**Calculi of Vesical Origin.**—Though a vesical calculus often owes its origin to the descent of a stone from the kidney, yet frequently there is no evidence of its coming from such a source, but every appearance of its being deposited in the bladder; a nucleus being originally formed in this viscus by the aggregation of some sabulous matters, around and upon which fresh deposits take place, until a true calculus is formed. In some instances, vesical calculi have been found deposited upon and incrusting foreign bodies, accidentally introduced into the bladder, such as a piece of straw, a pin, a bit of bougie, fragment of bone, &c.

NUMBER.—The number of calculi in the bladder varies considerably; most commonly only one is encountered; but in about one-fifth or one-sixth of the cases operated upon, several will be found; from two to six or eight are by no means uncommonly met with. Occasionally several dozens have been detected; and there are even instances on record in which some hundreds of distinct and separate calculi have been found in one bladder. The most remarkable case of this kind is one in which Physick removed from a judge in the United States upwards of a thousand calculi, varying in size from a partridge-shot to a bean, and each marked with a black spot. Several calculi may become matted together in one large concretion, as in the annexed representation of a calculus (Fig. 720) that I removed from a child four years old; it was formed of eleven distinct lithic acid calculi soldered together in this way; besides which, three others were lodged in the bladder. When two or more calculi occur, it is remarkable how uniform they are often in shape, size, and weight, one being the exact counterpart of the other.

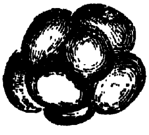


Fig. 720. — Uric Acid Calculi matted together.

When there are several calculi in the bladder, the attrition of one against the other usually causes the opposing surfaces to become smooth, thus constituting "facets" (Fig. 721). In some cases, however, when the calculi are numerous, there are no signs of attrition. In a patient of mine who had fifteen calculi in his bladder, all the stones were round, about the size and shape of marbles, without any facets. In other cases, again, there may be more facets on one calculus than companion-calculi in the bladder. A second stone may occasion two or even three facets on the first, having rolled first to one and then to the other side of it.

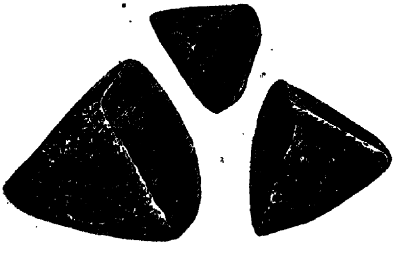


Fig. 721.—Calculi with Facets.

**Spontaneous Fracture** of a calculus will sometimes occur within the bladder. This curious phenomenon may happen to a stone that is single, or to one among several calculi. When it occurs, great irritability of the bladder is set up. There are several ways of explaining this fracture, or rather disintegration, of a calculus. Civiale supposes it to occur by the contraction of the hypertrophied coats of the bladder upon the stone. It is possible that, when there are several calculi in the bladder, the concussion of one against another may give rise to it; and for the breaking up of a calculus to happen, it would by no means be necessary that this pressure of the bladder or concussion should be sufficiently strong to resolve the stone at once into fragments. If a crack or fissure merely be formed in it, the infiltration of the urine into this may so soften and loosen its cohesion, that it becomes resolved, without further violence, into a number of pieces. In some instances these become agglomerated together, by the deposit of a quantity of phosphatic matter upon and around them. In other cases, the different fragments may each form the nucleus of a fresh calculus, so that the bladder may afterwards contain numerous concretions.

PHYSICAL CHARACTERS.—The **Size** of calculi varies from that of a hemp-seed or pin's head to a concretion of immense magnitude. One of the largest with which I am acquainted, was a calculus removed by the high operation by Uytterhoeven of Brussels, which I saw some time ago in his possession, and of which he has been obliging enough to give me a cast; it is pyriform, and measures 9½ inches in its longest circumference, and 12½ inches round at its broadest part, being 6½ inches long, and about 4 wide. In the celebrated case of Sir W. Ogilvie, Cline attempted, but failed, to extract a calculus measuring 16 inches round one axis and 14 round the other. It weighed 44 ounces, and must have been about the size of Uytterhoeven's. These enormous concretions are happily rarely met with at the present day; the usual size of stones removed by operation being from about one to two inches in the longest diameter, somewhat narrow, and perhaps flattened.

The **Weight** of calculi commonly varies from a few grains to several ounces; the commonest weight is from three drachms to about an ounce or two in weight, occasionally from three to six; from this they may range upwards until several pounds are reached. Thus, in Cline's case the stone weighed 44 ounces. Deschamps saw one of 51 ounces, and Morand one weighing 6lbs.: none of these admitted of removal. The largest calculi are usually composed of phosphates, in greater part if not in whole. Large and heavy calculi are certainly less frequently met with now than formerly, owing to operations for stone being simpler and less dreaded since the introduction of anæsthetics, and hence practised in an earlier stage of the disease.

The **Hardness** of calculi varies considerably; the oxalate of lime is the hardest; the lithates come next in consistence, and are often very hard, though brittle; the phosphatic calculi are always comparatively soft and friable.

The **Shape** of calculi presents great variety; most commonly, however, they have an ovoid figure. Concretions of urate of ammonia and uric acid are generally pretty regularly ovoidal, smooth, and disc-like. Those composed of oxalate of lime are usually somewhat globular or square-shaped, and generally rough, nodulated, or spiculated upon the surface. The phosphatic calculi present usually the most irregular outline; most commonly, it is true, they are ovoid or globular, but are not unfrequently branched, as if moulded to the interior of the kidney, constricted, or of an hour-glass shape. The cystine calculi are generally tolerably oval and regular in outline.

**Position.**—Most frequently calculi lie loose in the bladder; but occasionally they may be fixed, either by being encysted, and then lying in one of the sacculi that have already been described within the walls of the bladder (Figs. 722 and 723); or by being fixed in and embraced by one of the ureters; and in other cases by being deposited upon, and partly included in, fungous growths.

Causes.—Whenever a foreign body of any kind, as a piece of broken catheter, &c., is introduced into the bladder, it will form the nucleus of a calculus, speedily becoming incrusted by calculous, probably phosphatic matter. But the causes of calculi occurring spontaneously are very obscure. There can be little doubt, it is true, that the different forms of concretion are connected with the varieties of diatheses that have already been described; and we may look upon the formation of a calculus as an indication of the existence, in a greater degree of intensity than usual, of the causes which ordinarily give rise to sediments or gravel; but why, in particular cases, aggregation into a calculous mass takes place, it is impossible to say.

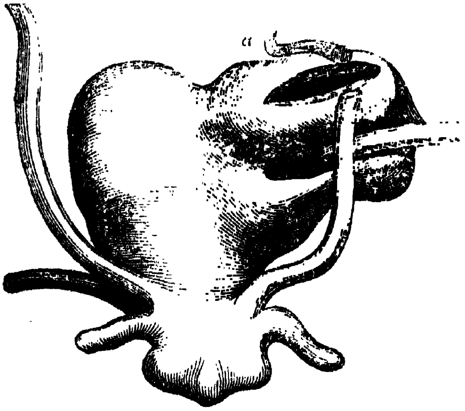


Fig. 722.—Exterior of Bladder, containing an Encysted Calculus at *a*.

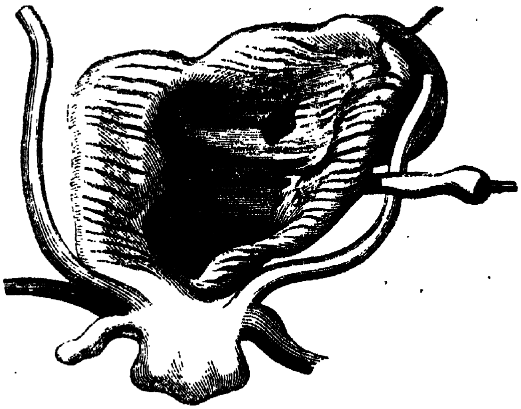


Fig. 723.—Interior of the same Bladder, showing small Orifice leading into Cyst at *a*: *b*, Ureter.

*Age* exercises considerable influence upon the production of calculi. Stone may occur in the bladder at all periods of life, and even, according to Stahl, may be congenital. The greatest number of cases occur during the first two decennial periods; thus, Thompson, as the result of his statistical inquiries, states that one-third of the entire number of cases occurs before seven years of age, and one-half of the entire number before the thirteenth year is completed. Coulson has collected 2972 recorded cases of lithotomy from various sources; of these, 1466 occurred under the age of ten, 731 from eleven to twenty, 205 from twenty-one to thirty; 264 from thirty-one to fifty, and 306 from fifty-one and upwards. In many of these cases, although the patient was cut towards the middle period of life, the stone probably began to be formed during childhood. Children belonging to the wealthy classes are very seldom the subjects of calculus, owing probably to greater care in diet than can be taken with those of poorer people. By many, the absence of milk as an article of diet is supposed to tend to the formation of stone.

*Sex* influences materially the occurrence of stone, which is far more frequent in the male than in the female, in the proportion of about twenty to one of cases requiring operation. This, however, does not represent the exact ratio; as, owing to the shortness and large size of the urethra in females, many small calculi are voided by them that would be retained in the male.

It would appear that *in some parts of the world* calculus is a far more common disease than in others. It is generally more frequently met with in cold than in warm climates. The negro race is remarkably exempt from this affection.

It is a singular fact that in some parts of the same country calculous disorders are of far more frequent occurrence than in others. Thus it is well known that the inhabitants of the east coast of England and Scotland are peculiarly liable to these disorders; and that in Norfolk stone occurs with especial frequency, the mortality from calculus being much higher here in proportion to the population than in any other county of England (Cadge). In America also, it would appear that the inhabitants of certain States are peculiarly obnoxious to this affection; and I understand that in some districts of Germany the disease may be said to be almost unknown, whilst in others it is of common occurrence. The relative frequency of the kinds of calculus also varies in different countries. H. V. Carter, who has analysed and described upwards of a hundred specimens contained in the Museum of the Grant Medical College at Bombay, shows that the per-centage of calculi with an uric acid or urate of ammonia nucleus is, in India, 56·30; in England, 71·79; while that of calculi with a nucleus of oxalate of lime is in India, 38·65, in England, 16·87. The calculi composed purely of oxalate of lime also greatly exceed in number those which consist entirely of uric acid or urate of ammonia. To what these differences are owing it is impossible to say. Peculiarity of race, of constitution, and of diet, with exposure to prevalent easterly winds, have all been assigned as reasons for them; but probably not on very sufficient grounds.

SYMPTOMS.—The symptoms of stone in the bladder vary according as the calculus lies loose in the cavity of the viscus or is encysted. Their intensity will depend on the size and shape of the stone, the condition of the bladder, and the constitution of the patient. Most commonly, the severity of the symptoms is in proportion to the magnitude of the calculus. This, however, is not always the case. In a patient whom I once cut, the most intense suffering and repeated attacks of cystitis had been occasioned by a small but sharp-pointed calculus, not weighing more than a drachm; and some years ago I saw a patient in whose bladder five calculi were found after death, nearly as large as chestnuts, though their presence had never been suspected during life by the different Surgeons under whose care he had been for stricture, so little distress had they occasioned. In some cases, the symptoms of stone very suddenly declare themselves; and then the Surgeon finds on examination that the patient has a largish calculus, which must have been a long time forming without attracting attention. Rough and angular calculi necessarily give rise to more severe symptoms than smooth ones, owing to their inducing a chronic form of cystitis; and as the constitution is usually a good deal shattered and the nervous system very irritable in those conditions of the system in which the phosphates are deposited, phosphatic calculi are usually attended by more local suffering and constitutional disturbance than other forms of the disease.

The symptoms induced by stone are the result of the mechanical irritation produced by the presence of a foreign body in the bladder; they consist of Pain, Increased Frequency in Micturition, occasional Stoppage of the Urine, and Various Morbid Conditions of that Fluid.

The *Pain* in calculus is often the first symptom that attracts attention; it varies greatly in character and degree. It may not only be experienced in the region of the bladder and the perinæum, but may radiate widely in the course of the sacro-lumbar nerves, the patient complaining of a heavy and dragging sensation in the groins, extending down the outside or back of the thighs, and not uncommonly experienced even in the soles of the feet. The penis is the seat of a good deal of uneasiness; frequently of a sharp and cutting pain at the end of the glans. This is especially noticed in children, in whom attention is often attracted to the complaint by their constantly squeezing and pulling the organ to relieve the distress they suffer in it. The pain is much increased by any movement by which the stone is jolted about in the bladder, as in driving, riding, or jumping; and is especially severe in those cases in which cystitis occurs. It is always most severe towards the termination of, or immediately after, micturition; as there is then a tendency for the calculus to roll forwards towards the neck of the bladder, where it comes into contact with and is grasped by the most sensitive part of that organ. Hence it is not unfrequent, in cases of calculus in children, to find that the little patient instinctively lies upon its back or side whilst passing urine, and thus escapes much of the agony that it would otherwise suffer. In adults in whom the prostate happens to be enlarged, the calculus usually lies in a depression behind this gland; and hence, being prevented from coming into contact with the neck of the bladder, occasions less suffering than in other cases.

In consequence of the irritation set up in the bladder occasioning chronic inflammatory action of the mucous membrane, there is an *Increased Frequency of Micturition*. The urine is passed frequently, in small quantities at a time, usually contains some mucus or pus, and is occasionally tinged with blood, or loaded with thick vesical mucus. But in many cases the urine remains remarkably clear, transparent, and free from marked admixtures throughout. If the kidneys be irritated, the urine is commonly albuminous. The presence of blood in the urine is often one of the earliest signs of stone in the bladder, and in children especially should lead to the suspicion of the existence of calculus. It may be in large quantities, and may continue for many weeks. especially in the earlier stages. The urine may then clear as the bladder becomes accustomed to the presence of the stone, and the blood may only reappear under the influence of active movement, or of any cause of increased irritation of the organ. But it is important to observe that the quantity of albumen, as shown by boiling the urine, will continue to be very great. It very rarely happens that a stone has existed for any time, without the urine becoming occasionally streaked or tinged by blood.

An occasional *Stoppage in the Flow of Urine* before the bladder is emptied commonly occurs, owing to the stone being impelled against its neck, and thus blocking up the urethra; but, on the patient lying on his back or on his side, the stream flows again, the situation of the calculus being changed.

As a result of the straining and general irritation about the genito-urinary organs, *Prolapsus of the Anus*, accompanied by *Tenesmus*, is by no means uncommon, especially in children; and in some cases there is very troublesome *Priapism*.

When a stone is *encysted*, those symptoms that depend upon its being loose and rolling about in the bladder, are necessarily absent; thus there is no stoppage of the urine, this fluid is seldom bloody, and the pain is not materially increased by jolts and rough movement; though there are weight and pain in the usual situations, and increased frequency of micturition from the pressure and irritation of the calculus.

Physical Diagnosis of Stone.—The existence of stone is finally determined by **Sounding the Bladder.**

A **Sound** is a solid steel instrument shaped like a catheter, but shorter in the curve (Fig. 724), so that it may explore thoroughly all parts of the bladder, especially those behind the prostate. It should have a wide and smooth steel handle, and be slightly bulbous. The operation of sounding is conducted as follows. The patient lies upon his back on a hard mattress ; a full-sized sound, well oiled and warmed, is then passed into the bladder ; which should, if the patient can retain it, be allowed to contain three or four ounces of urine. The Surgeon then using his left hand, or crossing over to the patient's right side, whichever he finds most convenient, carefully directs the beak of the instrument towards the back of the bladder, turning it from right to left over the whole of that region ; he next draws it forward on one side as far as the neck, tapping, as it were, gently with its beak ; he repeats the same manœuvre on the other side ; and, lastly, directs the end of the instrument by raising its handle into the lower fundus, which he carefully explores. Usually the stone is readily detected by these manœuvres, and its position in the bladder will often be dependent upon, and may to a certain extent be taken as an approximative indication of, its size. Thus, when moderately large, it will usually be found lying to one side, most generally the right, of the neck of the bladder ; when small, it will be placed towards the fundus, near the orifice of one or other ureter. These then are the situations in which the Surgeon should first seek for a stone, and in which he will generally find it when present. Should it not be met with here, the chances are, more especially if the patient be elderly, that it will be found in a pouch behind the prostate, where it may be detected by depressing the handle and so turning the beak of the sound downwards (Fig. 725). Should the Surgeon not detect the calculus in any of these situations, he depresses the handle between the thighs, and tilts up the beak so as to examine the pubic portion of the organ (Fig. 726). In the event of his not meeting with a stone, he may direct the patient to stand up, and then he may

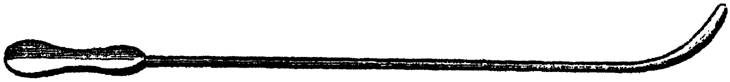


Fig. 724.—Sound for examining Bladder.

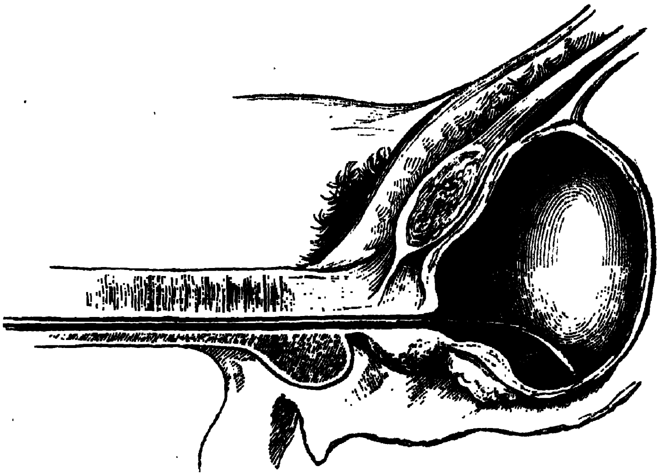


Fig. 725.—Sounding for Stone behind Prostate.

explore the bladder, first on one side, then on the other. Should the rational symptoms of stone be well marked, though no calculus be struck, the Surgeon must not give a decided opinion in the negative after the first exploration, but should examine the patient again a few days later, with the bladder in different states as to its contents. In making this second examination, I have found it of great service to use a hollow steel sound, by which the organ can be injected or emptied at pleasure (Fig. 727). The patient should on this occasion have his bladder injected through such an instrument as this, with four or six ounces of tepid water, so as to distend the organ slightly, and prevent the folds of mucous membrane from overlapping any concretion that may exist in it. Its interior is then carefully explored in the way already described; and, if the stone cannot then be detected, the contents of the bladder are gradually allowed to escape through the sound, and the patient is desired to stand up whilst the exploration is being proceeded with. In this way, by examining a patient in different positions and in different conditions of the bladder as to capacity, a calculus is sure to be detected if one exist. A lithotrite may occasionally be advantageously used as a sound for the detection of small calculi lying behind the prostate, a situation more readily reached by its short beak than by an instrument of larger curve. These examinations must not, however, be too protracted; the time occupied should not exceed above five minutes, lest cystitis be induced. When a stone is struck by the sound, there is not only a characteristic and distinct shock communicated to the instrument, but there is heard a tolerably loud click, which can be detected by the bystanders, and frequently by the patient, as well as by the Surgeon.

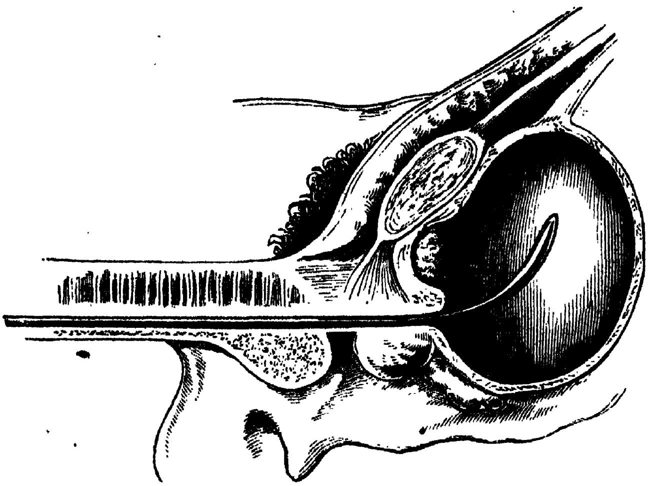


Fig. 726.—Sounding for Stone above Pubes.

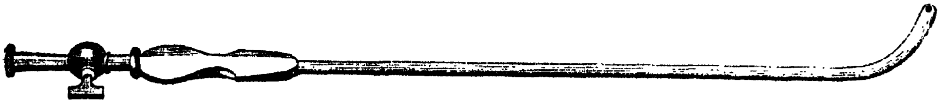


Fig. 727.—Hollow Sound.

By conducting the sounding properly, the Surgeon may usually ascertain not only the existence of a stone, but its size and hardness; whether it be single, if it be encysted, and the general state of the bladder; with all of which it is of importance that he should be acquainted before undertaking any operation. A good deal of this information may be elicited by the ordinary sound, but some of the points can only be accurately determined by sounding with the lithotrite.

The *hardness* of the stone may usually be judged of by the more or less clear ringing character of the click; a lithic acid or oxalate of lime calculus giving a sharper sound than a phosphatic concretion.

A calculus may generally be known to be *encysted* if the sound strike it at times, but not at others (Fig. 728); if the stone always appear to be fixed in one situation; and if the beak of the instrument cannot be made to pass round it, so as to isolate it, but a kind of tumour projecting through the walls of the bladder is felt, around or on one side of the point where the calculus is struck.

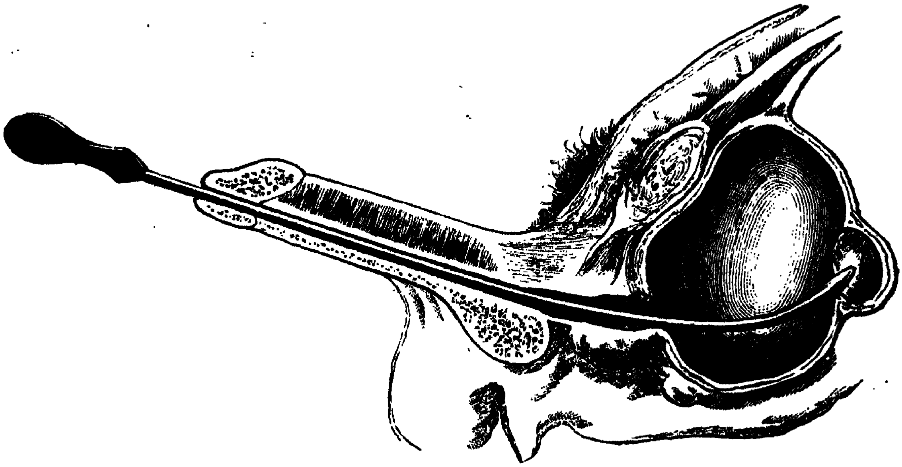


Fig. 728.—Sounding for Encysted Calculus.

The fasciculated, roughened, and sacculated *condition of the bladder* may generally be detected by the way in which the beak of the instrument grates and rubs over the organ.

The *size* of the calculus is best determined by a lithotrite. It is true that a Surgeon may sometimes come to a decision as to the bulk of a calculus, by observing the extent of surface along which the sound is in contact with the stone, as the instrument is being withdrawn. But a very rough guess only can be arrived at in this way; and I have frequently seen very experienced Surgeons deceived in their estimate of the size of a calculus, mistaking perhaps several small ones lying together for one large one. By introducing a lithotrite and seizing the calculus gently between its blades, a correct estimate of its size may always be arrived at.

In order to determine that *several calculi* exist in the bladder, it is sometimes sufficient for the Surgeon to feel that the beak of the sound comes into contact with a stone on each side of the organ, or that it can be distinctly insinuated between two concretions. In some cases, however, these points cannot clearly be made out; and then the Surgeon, introducing a lithotrite and seizing the first calculus with which he meets, should hold this between the blades of the instrument, and whilst it is so fixed move it and the lithotrite from side to side; when, if a click be heard and felt, he may be sure of the existence of another stone.

Sounding is by no means destitute of danger, more especially if roughly done, or in patients who have chronic kidney-disease. In the first case it may give rise to cystitis or profuse and continuous hæmorrhage ; in the second, to rigors and uræmia.

**Errors in Sounding** occasionally occur. The Surgeon may mistake a hardened and fasciculated bladder, having its ridges perhaps incrusted with phosphatic sabulous matter, for a calculus ; this is especially apt to happen in children. In these cases, however, the mistake may usually be guarded against by the absence of a distinct click, though a rough grating sensation be experienced, and by the Surgeon being unable to isolate a stone. Yet the difficulty in some cases is great; Velpeau states that he is acquainted with four instances, and S. Cooper with seven, in which patients have been cut and no calculus found ; and when we reflect that these accidents have happened to such men as Cheselden, who on three occasions cut a patient and found no stone, to Crosse, to Roux, and to Dupuytren, it is easy to understand that in some cases the difficulty of coming to a correct decision must be very great.

In *women* the symptoms of stone closely resemble those met with in men, and the detection of the calculus is usually very easy, owing to the shortness of the canal and the facility with which the stone may be tilted up by introducing the fingers of the left hand into the vagina. The sound used in these cases should be shorter and less curved than that employed for the detection of calculus in the male bladder.

PATHOLOGICAL CHANGES INDUCED BY CALCULUS.—After a stone has existed for some time in the bladder, it induces serious pathological changes in the whole of the urinary apparatus. The *urethra* usually becomes slightly dilated; and the *prostate* not unfrequently somewhat enlarged and irritable, in consequence of which a kind of pouch is formed behind it, in which the calculus is apt to lodge. The most important changes, however, take place in the bladder and kidneys. The *bladder* becomes extremely sensitive, especially about its neck, and is consequently unable to contain as much urine as usual ; hence it becomes contracted. In some rare instances, however, as will be more especially noticed when we come to speak of lithotrity, it falls into an atonic condition, and then is apt to become rather largely dilated. The mucous membrane is commonly a good deal inflamed and irritated by the presence of the calculus ; and the muscular coat becomes thickened and hypertrophied, so as to give it a very fasciculated or columnated appearance. Cysts occasionally form, containing sabulous matter and fetid pus or urine, and in some cases lodging a concretion, which then constitutes an encysted calculus lying altogether outside the cavity of the bladder, with which it merely communicates by a very narrow aperture, as in Figs. 722 and 723, representing a case that was under my care some years ago, and which is fully described in the Journals for March, 1858. The *kidneys* are usually irritated, often congested, frequently in a state of granular degeneration, and ultimately become the seat of such structural changes as are incompatible with life. When death occurs as the consequence of stone, the patient usually sinks, worn out by protracted suffering and kidney-disease.

## LITHOTOMY.

It is not my intention to enter into the general history of lithotomy, an operation that has been practised from the earliest ages ; nor to give a sketch of the gradual modifications that have at various times been introduced, from the rude attempts of the Greek and Roman Surgeons to the barbarous and unscientific procedures adopted by the itinerant operators after the revival of letters. For all this, I would refer the reader to the classical works of Deschamps and of John Bell. The operation, as now generally practised in this country, is essentially that introduced by Cheselden, and modified more or less according to the views of particular Surgeons. Though Surgeons generally are agreed upon the great principles involved in it, they differ in carrying these out; as in the direction and extent of the incisions, and in the instruments employed, which have been much varied to suit the tastes and views of particular operators. But, although I look upon Cheselden's operation, as modified and practised by Liston, as being on the whole the simplest and safest mode of cutting for the stone as yet introduced, there can be no doubt that recourse may occasionally be had with advantage to other methods instead of it. Indeed, there is no operation that requires to be considered from so many and such different points of view as lithotomy. The size, shape, and position of the stone, the age and constitution of the patient, all render it desirable, and indeed necessary, to modify the method of operating. Hence, a Surgeon should not be too exclusively wedded to one plan, but should adopt one or other of the methods about to be described, according to the exigencies of the particular case before him.

**Instruments.**—The table for operating must be firm and of convenient height, so that when the Surgeon sits on a rather low stool the patient's nates will be on a level with his breast; a few blankets doubled should be laid upon the table, and covered by a piece of tarpaulin hanging over the end; and a tray of sand placed under it on the floor. The instruments necessary are the following:—a pair of lithotomy tapes, a sharp and probe-pointed scalpel, a staff, forceps, and scoops of various sizes, and a tube. To these may be added a searcher, and a brass injecting syringe.

The *tapes* should be of coarse flannel, about three yards long, by three inches broad.

An infinite amount of ingenuity has been expended in giving variety to the shape of the *knives* used for opening the deeper portions of the urethra and neck of the bladder in lithotomy. Instruments of this kind, straight-edged and shouldered, beaked and probe-ended in every possible way, have been devised; and each has had its special advocate, but has seldom been adopted in practice by any except its inventor. All these modifications of the ordinary scalpel are, to say the least, useless; some, perhaps, actually dangerous. They simply seek to supply by mechanical means that safety in the deeper incisions which may as readily be secured by a broad-bladed, straight-backed scalpel, if properly guided by a hand that is ordinarily skilful.

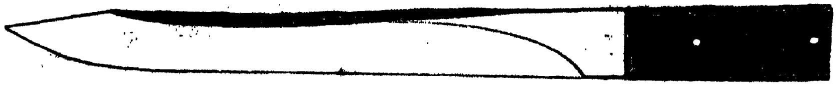


Fig. 729.—Lithotomy Scalpel.

The cutting gorget, formerly much in vogue, is all but universally discarded as a most dangerous tool by the modern lithotomist.

The *scalpel* for the adult may be of the size and the shape represented (Fig. 729); for children, it may be made smaller. A *probe-pointed lithotomy knife* of the size and shape here represented should also be at hand (Fig. 730).

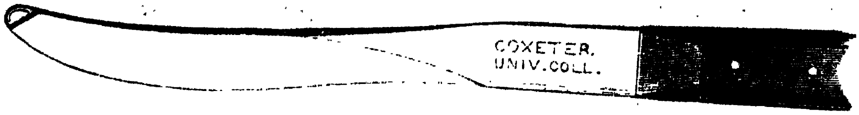


Fig. 730.—Probe-pointed Lithotomy knife.

The *staff* should have a deep groove on its left side, occupying nearly one-third of the instrument; it should be well curved, of as large a size as the urethra will admit, and have a roughened handle (Fig. 736).

The *forceps* must not be too heavy, but should be of a good length in the handles, and have the joint well set back; the inside of the blades, as recommended by Liston, should be lined with linen to prevent the stone from slipping (Fig. 732). Coxeter has made them with open blades, but lined with linen as heretofore (Fig. 731); in this way, as there is less metal, the weight is diminished, and the diameter of the instrument with a stone in its grasp is materially lessened. The ordinary forceps are straight, but it is advantageous to be provided with some that are curved (Fig. 733). The handles should be made with a loop on one side and a ring on the other; the ring for the reception of the thumb should be placed somewhat obliquely. The *scoops*

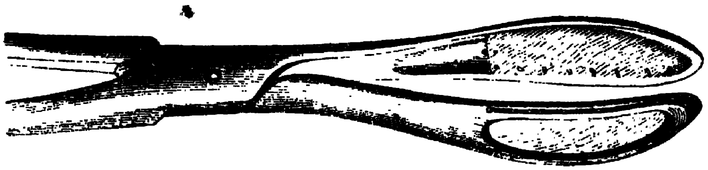


Fig. 731.—Open-bladed Lithotomy-forceps, lined with linen.

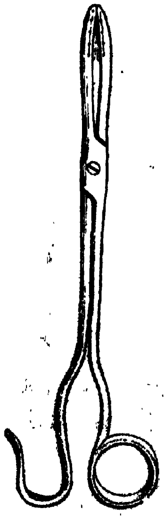


Fig. 732.— Forceps.

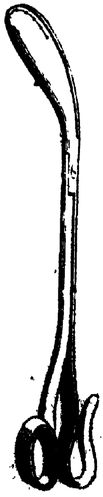


Fig. 733.— Curved Forceps.

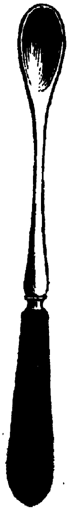


Fig. 734.— Scoop in Handle.

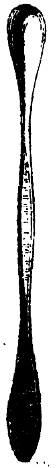


Fig. 735.— Scoop.

Fig. 736.— Staff.

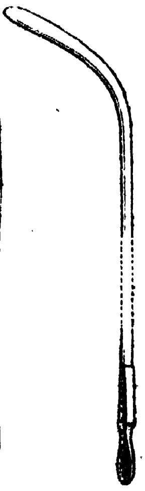


Fig. 737.— Searcher.

of different sizes, and curved, can most conveniently be used when fixed in a roughened handle (Figs. 734 and 735). The *tube* should be of silver or gum-elastic, well rounded at the end, and provided with silver rings, and may be petticoated. The *searcher* is a slightly curved sound, having a bulbous extremity (Fig. 737). The *syringe* should be provided with Gross's ball nozzle, which propels a reversed current.

In describing the operation of lithotomy, we shall first of all examine *seriatim* the different steps of an operation that presents no unusual complication or difficulty; we shall then consider the difficulties that may be met with, and the accidents that may occur during the operation, and the principal sources of danger and the causes of death after its performance.

**Preparation of the Patient.**—Before subjecting a patient to operation, his general health must be properly attended to; and, indeed, if we find the constitution much broken by prolonged suffering, the bladder or kidneys seriously diseased, as indicated by the existence of pus or albumen in large quantity in his urine, it will be wise to postpone the operation for a time, or perhaps even to defer it altogether. There are few conditions in which a Surgeon is placed, that test his moral courage more severely than the refusal to operate on a patient for stone, and thus allowing him to die unrelieved. For a Surgeon to do this, unmoved by the entreaties of the patient and of his friends, requires no little self-reliance. Yet, when the patient is greatly emaciated, his constitution broken down, and his kidneys evidently disorganised extensively, lithotomy would be attended by an inevitably and rapidly fatal result, and the performance of an operation would be an useless act of cruelty. Supposing, however, that the stone is of moderate size, that the urine is either healthy or contains but a moderate quantity of pus or albumen, that there is no visceral complication to prevent the performance of the operation, and that the patient's health is in a tolerably good state, it will only be necessary to subject him to proper preparative treatment for a short time, so as to allay or remove irritability of the urinary organs before proceeding with it. With this view he should be kept as quiet as possible for about a week or ten days preceding the operation; his diet should be properly regulated, but not too low; the pain should be lessened by the administration of opiates or henbane, and the bowels properly relieved. On the day preceding the operation, a dose of castor-oil or some other aperient should be administered; and on the morning of the operation the rectum must be emptied by means of an enema.

LATERAL OPERATION.—All the urine contained in the bladder having been drawn off, that organ should be filled by the injection of about six or eight ounces of tepid water, in order to steady it and to facilitate the seizure and extraction of the stone. After chloroform has been administered, the Surgeon should introduce a full-sized staff, which he uses as a sound, in order to feel for the calculus. If he detects it, he proceeds with the operation; if he cannot detect it, it is usually recommended that he should withdraw the staff and introduce a sound, with which he examines the bladder; and, in the event of his still failing to discover the presence of the stone, the operation must be deferred, for it is an imperative rule in surgery that lithotomy should never be performed unless the stone can be felt at the time when the patient is actually on the table. It is, however, safer not to proceed with the operation unless the stone can be felt with the staff; lest the point of this, though apparently in the bladder, be actually engaged in a false passage. The stone, then, having been felt, the patient is to be firmly tied up and brought to the end of the table, so that his nates project beyond it, where he is to be securely held on each side by an assistant, who grasps the foot in his hand, places the patient's knee under his arm, and draws the limb well aside, so that the perinæum may be fairly exposed. It is desirable that the perinæum be thus fully exposed to the Surgeon. In a patient, however, on whom I once operated, this could not be done, owing to the left hip being stiffened by chronic rheumatic arthritis; but I did not experience any particular difficulty in the operation, though somewhat inconvenienced by the position of the limb. The Surgeon then, seating himself before the patient, shaves the perinæum—if this have not already been done—and introduces his finger into the rectum to ascertain that the gut is empty. He then gives the staff into the charge of a trusty assistant, who stands on the patient's left, and who raises and draws aside the scrotum with the left hand whilst he holds the staff in the right (Fig. 738). The Surgeon then sees that the staff is held in the way in which he prefers it. There are two ways in which it may be held; it may either be drawn well up into the arch of the pubes, or it may be pushed somewhat down, and slightly turned towards the left of the perinæum. Liston always employed the first method, which I certainly think is the best, as it tends to increase the space between the urethra and the rectum, and consequently lessens the danger of wounding that gut, which more than counterbalances the advantage of the other method—that of approaching the membranous portion of the urethra to the surface.

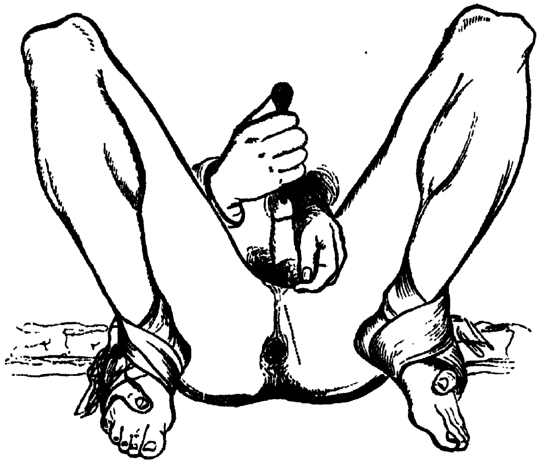


Fig. 738.—Position of Patient and Line of Incision in Lateral Lithotomy.

The external incision is made by entering the knife in the raphe of the perinæum, one inch and a half above the anus, and carrying it downwards and outwards, until it reaches a point that is just below the anus, but about one-third nearer to the tuberosity of the ischium than to the margin of the anal aperture (Fig. 738). It is useless to prolong the incision beyond this, as any freer division of the structures of the scrotum and on the nates cannot facilitate the extraction of the stone; but it must occupy the extent indicated, otherwise considerable difficulty may be experienced in the later steps of the operation. The depth to which this incision should be carried must vary according to the obesity of the subject; usually from about three quarters of an inch to an inch, but not so deeply above as below. By this incision the skin, superficial fascia, subcutaneous fat, and inferior hæmorrhoidal vessels, are divided. After it is completed, the knife is again introduced a little below the upper part of the wound, and the blade is run lightly downwards over any resisting structures; the left fore-finger being placed at the middle of the wound, so as to protect the rectum. In this way the transversalis perinæi muscle is divided, together with some areolar tissue and small vessels, and the triangular space is opened between the accelerator urinæ and erector penis muscles. The lower border of the triangular ligament is notched so as to open up the space between the two layers of the triangular ligament, in which the membranous part of the urethra lies. The knife is then withdrawn, and the left index-finger is pushed deeply into this space until the edge of the nail is lodged in the groove of the staff (Fig. 739), which can be felt just anterior to the prostate, thinly covered by the membranous portion of the urethra. The point of the knife is then pushed through the urethra at its membranous part into the groove of the staff, above the index-finger, which protects and presses to the right the rectum lying beneath it (Figs. 740 and 741).

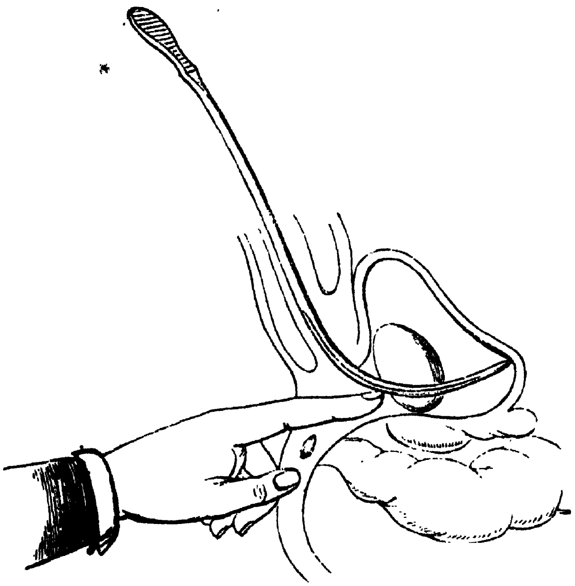


Fig. 739.—Lateral Lithotomy: Finger-nail in Groove of the Staff.

When the knife is felt to be well lodged in the groove, its handle is slightly depressed, so that the point may be raised; at the same time the blade should be somewhat lateralised so that its side lies parallel to the ramus of the ischium. If the edge be turned too directly downwards towards the mesial line, the rectum may be wounded; and if it be directed too much outwards the internal pudic artery will be endangered (Fig. 742); hence the mid course is the proper one.

The Surgeon, keeping the knife steadily in this position, and pressing the point firmly against the side of the groove of the staff, which he must never for a moment lose, pushes it forwards through the deep perineal fascia, a few fibres of the levator ani, and the prostate, and thus makes an entry into the bladder (Fig. 741); he then withdraws the knife by keeping its back against the staff, so as not to enlarge the extent of the incision in the prostate. Through this, and along the staff,

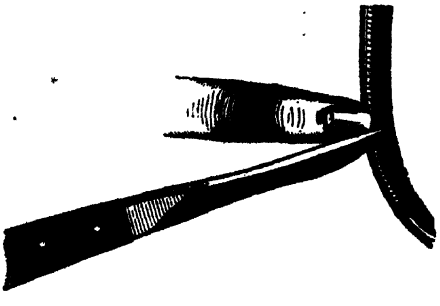


Fig. 740.—Knife in Groove of Staff.

he then pushes his left index-finger until it reaches the bladder, when he endeavours to feel the calculus with its tip. Should his finger be short, the perinæum deep, or the prostate enlarged, he may be unable to reach the bladder in this way ; and must then introduce a blunt gorget, as recommended by Cheselden and Martineau, in order to dilate the aperture in the prostate. If he use his finger for this purpose, he gives it a twist or two after passing it through the prostate, so as to expand and dilate the aperture through which it is entered. Having made sure that it is in the bladder, and having, if possible, felt the stone, he directs the assistant to withdraw the staff from the urethra.

Here let us pause, and examine the principal points in these the first and second stages of the operation. It will be observed that, in accordance with the best authorities upon this subject, and with my own experience, I have recommended the external incision to be free, the rectum to be protected by the left index-finger, the knife to be somewhat lateralised during and after the opening of the urethra, and the deep incision to be limited.

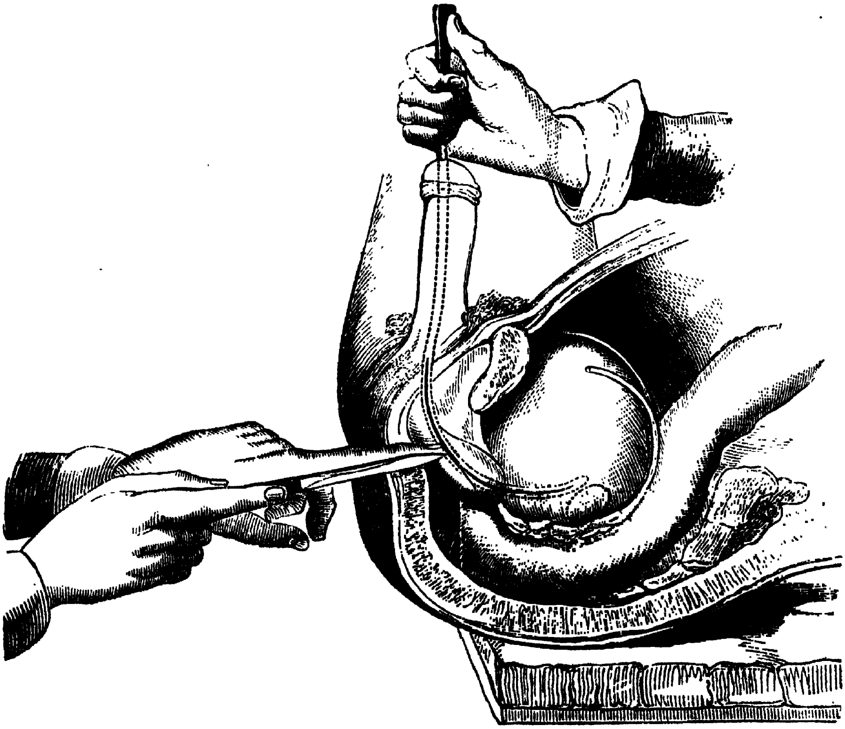


Fig. 741.—Second Stage of Lithotomy.

1. The **Position of the Knife** must be carefully attended to, especially during the deep or second incision. At this stage of the operation the edge should be *lateralised;* that is, directed about midway between the horizontal and perpendicular positions, so that the surface of the blade lies nearly parallel to the ramus of the ischium. The manner of holding the knife has been much discussed, and necessarily and naturally varies with different Surgeons. I believe it signifies little how the handle of the instrument is held between the

Surgeon's fingers, provided the edge be never turned upwards, but be always kept well lateralised, and the point steadily pressed into the groove of the staff.

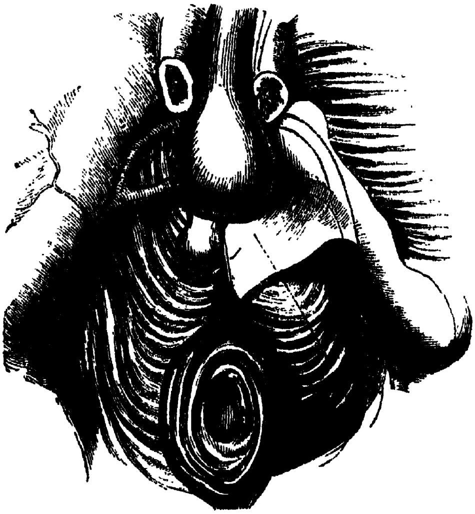


Fig. 742.—Arteries of Perinæum, and Deep Fascia.

Provided a Surgeon know what he is about, he may safely hold his knife as best suits his own convenience. In the first incision, most operators, I believe, hold the knife *under* the hand, as represented in Fig. 743; a position which that excellent lithotomist and accomplished Surgeon, Fergusson, preserves throughout the operation. Liston, in the early part of his career, appears to have held the knife, in the second stage of the operation, *above* the hand; and in all the representations, published as well as unpublished, that he has left off his operation, he has depicted the kinfe and hands in the position shown in Fig. 744; which, in the last edition of his *Practical Surgery*, he describes as a correct sketch of "the position of the hands and knife" at the commencement of the second stage of the operation. There can be no doubt, however, as Fergusson has pointed out, that in actual practice, at least after his first few years as an operator, he held the knife under the hand, with the index-finger upon the side or the back of the blade.

For my own part, I believe that every Surgeon will hold the knife in the way which he finds most convenient, and, as it were, natural to him. If any rules can be laid down on this point, I should say that, in operating on a child, or on an adult with a shallow perinæum, the knife is most conveniently held as represented in Fig. 745. But if the patient be fat, and the perinæum deep, then I think that it is a question whether greater steadiness may not sometimes be secured by holding the knife somewhat in the manner of a gorget, with the index-finger,

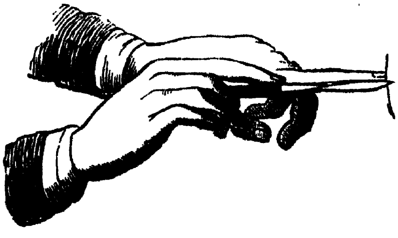


Fig. 743.—Position of Hand and Knife (Fergusson).

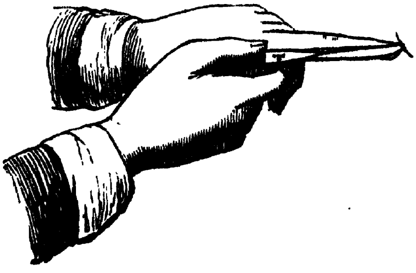


Fig. 744.—Position of Hand and Knife (Liston).

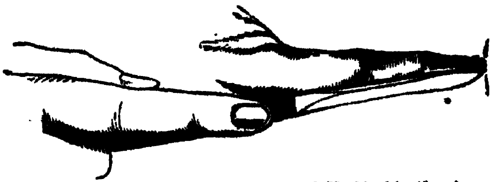


Fig. 745.—Position of Hand and Knife (Author).

perhaps a little more upon the side of the handle (Figs. 741 and 745); in this way the point is firmly pressed into the groove of the staff, out of which it cannot slip, as it is secured and supported by the index-finger being somewhat under it. The section of the prostate is thus made by a steady push or thrust of the knife forwards, and not by any cutting movement downwards. No danger can result in the deep incision from pushing the point of the knife up into the groove of the staff; but there is great danger of missing the bladder, and entering the recto-vesical space, if it be at all depressed and the handle raised, though this cannot always be avoided if the staff be pushed deeply into the bladder.

2. The **Incision into the Prostate** in the adult should be of very limited extent: on this point, I believe, all Surgeons of the present day are agreed. Scarpa advises that the incision into it should not exceed five lines in adults, and two in children. It is difficult to measure the extent of the incision: it is sufficient to say, that it should be as limited as possible; and if care be taken to push the knife in, with the point well pressed against the groove, and the blade forming but a limited angle with the shaft of the staff, and especially in withdrawing it that it be brought carefully back over the finger and still in contact with the instrument, there will be no danger in cutting too widely, or in doing more than merely notching the apex of the prostate (Fig. 746 *a*). The danger, however, it must be borne in mind, does not consist in the section of the prostate itself—which is in reality a structure of but little importance—but in cutting beyond it into the reflections of the pelvic fasciæ, which will be opened up if the base of the prostate be cut, and the wound of which will, almost to a certainty, be followed by urinary infiltration and diffuse inflammation.

That distinguished anatomist Ellis has, I believe, for many years taught that the true separation between the cavity of the pelvis and the internal parts, in which a lithotomy wound can be safely made, is not the sheath of the prostate, but the lateral and anterior true ligaments of the bladder; or in other words, the recto-vesical fascia. Hence the incision may be safely carried through the whole length of the lower and outer side of the prostate up to the very neck of the bladder, provided it do not pass beyond the attachment of the lateral ligament to the bladder, and so open up the loose subperitoneal tissue around this viscus.

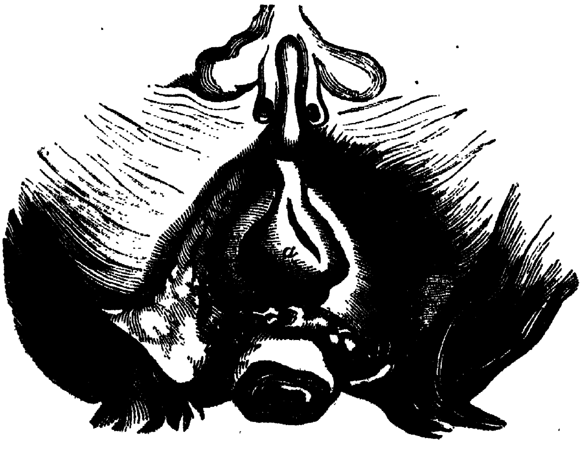


Fig. 746.—Incision in Prostate.

In the section of the prostate, then, two points have specially to be attended to: one is, that the knife in entering be not pushed forwards at too great an angle with the staff, so as to cut widely; and the other is, that in its withdrawal the blade be kept steadily in contact with the staff. Indeed, I believe that there is more danger of doing mischief in the withdrawal than in the entry of the knife; for, if it leave the staff for a moment, all guide is lost, and the edge may sweep downwards through the base of the prostate and its investing capsule. As the knife is withdrawn, the left index-finger is pushed forwards into the aperture in the prostate, which is then dilated by its pressure to a sufficient extent for the introduction of the forceps, which are slipped in as the finger is withdrawn, and for the extraction of the stone. This part of the operation may very conveniently be performed, as was usually done by Liston, at the moment when the Surgeon is stooping down, engaged in selecting his forceps. The dilatation of the prostate is readily effected; for this structure, though dense, is friable, and breaks down easily under somewhat forcible pressure by the finger. In this way, by a mere notching of the prostate,—by a slight section of its apex or urethral surface, followed by simple dilatation with the finger,—sufficient space will be obtained for the extraction of all moderate-sized calculi, without the employment of any violence, or the infliction of any bruising upon the tissues.

But another obstacle exists which will prevent the dilatation of the neck of the bladder to any very material extent, without an amount of bruising, or laceration, or even rupture that would probably prove fatal to the patient. This obstacle consists of a firm resisting tissue, which has been described by Tyrrell as "an elastic ring," surrounding the neck of the bladder; by Liston as "a fibrous or ligamentous band surrounding the orifice of the bladder, into which the muscular fibres of the organ are inserted." If this ring or band be ruptured, either by the finger or by the expansion of the forceps, fatal consequences will ensue; but if it be divided, the other tissues, as Liston observes, will yield to an inconceivable extent, without injury to the ilio-vesical fascia. The division of this ring must only be practised to a very limited extent. I believe that it is always affected in the act of pushing the scalpel inwards into the bladder; a mere notching of the fibres of the ring, indeed, is sufficient to allow the requisite expansion to take place when pressure is applied.

In thus describing the mode of incising the prostate and neck of the bladder, I have, generally, used the term "dilatation;" and I believe that, by a simple process of dilatation or expansion of these parts, and without any violence whatever, small calculi of or under on inch in diameter may be extracted. In fact, for the removal of such stones, no force whatever is required, either in opening up the prostate or in withdrawing the calculus. But, in removing stones of greater magnitude than this, I believe that the process of expansion of the prostate and neck of the bladder, whether effected by the finger, by a blunt gorget, or by the opening up of the blades of the forceps, is a process of laceration rather than of dilatation, as I have frequently had occasion to observe in experiments on this point made on the dead subject. If this laceration be, however, confined to the substance of the prostate, and do not extend through the lateral ligament of the bladder, and into the fasciæ of the pelvis, no harm results. It is difficult, with ordinary force, to lacerate the dense ligament. This structure, therefore, remains as a firm unbroken barrier between the pelvic fasciæ and the external wound, preventing the possibility of the infiltration of urine into the internal subperitoneal areolar tissue, and lessening materially the chance of the extension of diffuse inflammation into the pelvic fasciæ. But if, in the withdrawal of the stone, or by an undue expansion of the blades of the forceps, the Surgeon feel a sudden giving way of a tense annular structure, he may be sure that the lateral ligaments have been torn, and that fatal mischief will ensue.

**Extraction of the Stone.**—A forceps of sufficient length, and of a size proportioned to that of the calculus, and previously warmed by immersion in tepid water, must be slid along the index-finger, which is kept in the wound, and by which the neck of the bladder should be drawn somewhat down so as to meet the instrument. In this way, also, the stone may often be fixed by the point of the finger, and its position thus accurately determined. The forceps having been introduced closed, the finger is withdrawn, when a gush of urine will usually take place through the wound, if that fluid have not already escaped at the time when the incision is made through the prostate. By this gush the calculus may, as Fergusson observes, sometimes be carried into the grasp of the instrument; most commonly, however, the stone requires to be felt for with the closed forceps. When its position has been ascertained, usually at the inferior fundus, the blades of the instrument are opened; and, by pushing one against the wall of the bladder, and giving it a slight shake, the calculus generally drops between them; though occasionally it is somewhat troublesome to seize, and this, indeed, often constitutes the most tedious and annoying part of the operation. The blades, having the stone in their grasp, are then closed, and the stone is drawn downwards through the wound. If it be small, it may be extracted at once without any difficulty; if it be of moderate size, the finger should be introduced along the blades, in order to feel whether it is in a proper position for extraction. If its long axis lie across the wound, this must be changed; and it must then be withdrawn by a kind of to-and-fro movement in the direction of the axis of the pelvis (Fig. 747). Should unfortunately the stone be broken, or should there be several small calculi, the fragments or the small calculi may generally be best removed by means of the scoop (Fig. 748). In the event of fracture occurring, it will be necessary to wash out the bladder freely and repeatedly with tepid water, injected by means of a brass syringe through a tube introduced by the wound.

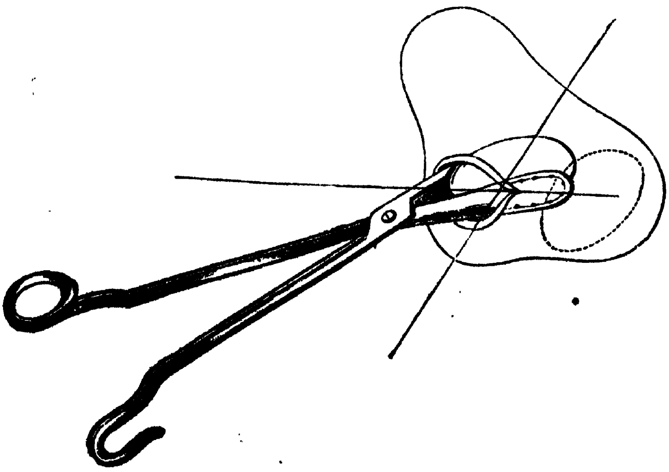


Fig. 747.—Direction of Forceps in Extraction of Stone.

If the perinæum be very deep, and the prostate enlarged, it may happen that the neck of the bladder is so far removed from the surface that the finger cannot reach its interior. In these circumstances, the Surgeon must be careful in passing the forceps, that the instrument do not slip to the side of the incision, the guide and support of the index-finger being lost. In two or three cases of this kind that have occurred to me, in which, owing to the anatomical reasons above stated, I could not reach the bladder with the tip of my fore-finger, I have directed the assistant who held the staff not to withdraw it, but, using it as a guide, have slipped the forceps along its groove and over its concavity, in this way making it enter the bladder with the greatest ease and certainty. This manœuvre I would strongly recommend in the cases alluded to.

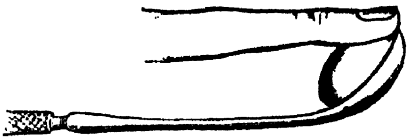


Fig. 748.- Position of Finger and Scoop in Extracting Stone.

It is of the first importance to extract the stone whole without breaking it, or even chipping fragments from it with the blades of the forceps. No effort consistent with the safety of the patient should be spared in obtaining this desirable result ; not for the sake of any vain display of manual skill, but from a regard to the well-being of the patient. If the stone become broken by the attempt at extraction, what happens ? The Surgeon is obliged to introduce repeatedly the forceps and the scoop in his attempts to clear the bladder ; the mucous membrane of which, falling upon and enveloping the fragments, is liable to be pricked, bruised, and excoriated in the endeavour to seize them. The bladder requires to be frequently washed out with copious injections of tepid water, and the operation thus becomes greatly and dangerously prolonged. Even after much time and labour have been spent in these efforts, fragments are apt to be left behind which may occasion great present irritation, and, if retained, will form the nuclei of future recurrent calculi.

In children, and indeed in most cases in which the perinæum is not very deep, so that after the introduction of the finger the stone can be felt and hooked forwards, the scoop is a most convenient instrument for its extraction ; and in these cases I have often employed it in preference to the forceps.

After the calculus has been removed, it must be examined for facets, or the interior of the bladder explored by means of a *searcher ;* and if other stones be found, they must be dealt with in the same way as the first.

The *gum-elastic tube* may then be introduced, and secured with tapes to a band round the patient's abdomen. This tube must be kept free from coagula by the introduction into it, from time to time, of the feather of a pen. The tube is of great service by preventing the wound from becoming blocked up by coagula, and the free escape of the urine consequently interfered with. By means of this tube a ready outlet is given to the urine, the chance of infiltration is lessened, and if there be hæmorrhage the wound may readily be plugged round it.

**Lithotome for Lateral Lithotomy.**—Surgeons have, at various times, expended much ingenuity on the construction of instruments calculated to facilitate the operation of lithotomy, and to enable the operator to make his incision with absolute precision. Most Surgeons prefer to rely on their own skill to accomplish this, and mechanical contrivances have very generally and perhaps somewhat unjustly been discarded. Of all the instruments of the kind referred to, that which is the invention of N. R. Smith, of Baltimore, is the most ingenious and practically useful.

This instrument consists of a staff with appliances (Fig. 749), and a peculiarly shaped bent cutting gorget (Fig. 750). It was first described and figured by Smith in 1831. It has undergone many modifications at the hands of its inventor, and is now given to the profession with all its improvements, as seen in Figs. 749 and 750.

The staff consists of three parts. 1. A rectangular tubular staff, with a wide slit making a quarter turn, so as to fit it for lateral lithotomy. 2. Attached to the staff by a hinge close under the handle, is an "arm-piece," or "conductor." This ends in a knife-blade, set at right angles to the shaft and deeply grooved at its under part. 3. An "indicator" consists of a slender rod traversing the handle of the staff and terminating in a cup sliding in the tubular staff.

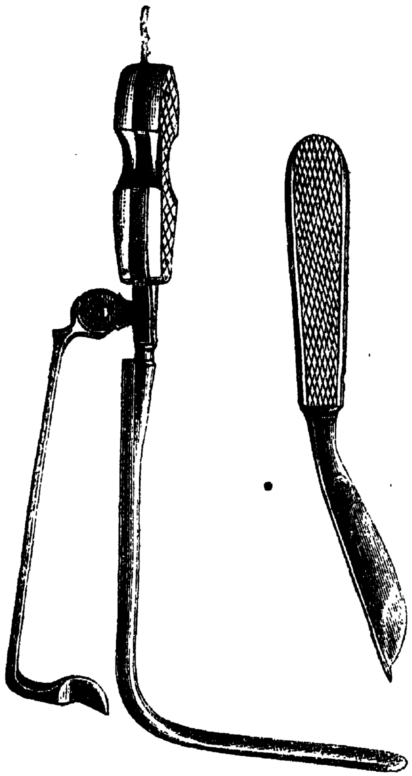


Fig. 749.—Smith's Lithotomy Staff and Conductor.
Fig. 750 (to right).—Smith's Gorget.

The mode of action of the instrument is as follows. The conductor being drawn back on its hinge, the rectangular staff is passed in the usual way into the bladder, the angle being brought just in front of the prostate and resting on the membranous part of the urethra. When the Surgeon has satisfied himself that the staff is in proper position, he draws down the conductor, and, pressing upon it, pushes its terminal knife through the tissues of the perinæum until it enters the slit in the staff. The groove in the "conductor" outside the perinæum is now continuous with that in the staff which is in the urethra. The "indicator" is now drawn up so that its cup lies immediately under the groove of the "conductor." The superficial incision having been made in the usual way, the urethra is opened on the groove in the "conductor;" the beak of the knife is then engaged in the cup of the "indicator," and as the knife advances the rod of the indicator descends, but ceases to move if the blade depart from the proper route by slipping out of the slit in the staff and stops when the end of the groove is reached.

The knife, or gorget (Fig. 750), ends in a blunt beak, and the handle is set at an angle to the blade, so as to enable the Surgeon to watch more accurately its attitude and position.

Professor Johnson, of Baltimore, has used this instrument many times, and speaks highly of its utility.

**After-treatment of Lithotomy.**—After the operation, the patient must be removed to a bed, which should be properly arranged by having a large square of Macintosh cloth put across it. On this a folded sheet should be laid, which must be rolled up on the further side, so that, as it becomes wetted by the escape of urine, it may be drawn across from under the patient. This must be changed frequently in order to keep him clean and dry. A full dose of tincture of opium in barley-water should then be given ; a warm flannel laid across the abdomen ; plenty of barley- or gum-water allowed for drink, and nothing but rice-milk or light pudding for diet during the first three or four days. After this some broth may be allowed, and the quality of the food gradually improved. Occasionally, however, it may be necessary to depart from this routine system of dieting the patient after lithotomy ; and I have, with great advantage, allowed wine, and even brandy, a day or two after the operation.

At the end of thirty-six or forty-eight hours the tube may be removed, the sides of the incision by that time having become glazed over, and little danger of infiltration existing. The patient, who up to this time has been lying on his back, should then be directed to change his posture, first to one side and then to the other. The buttocks and hips should be well oiled, so as to prevent the irritating effects of the urinary drainage. The urine continues to flow entirely through the wound for the first four or five days. About this time it frequently suddenly ceases to do so, escaping by the urethra. This is owing to the prostate becoming turgid by inflammatory action, and thus blocking up the aperture in it ; but as this swelling goes down, in the course of a day or two, the urine usually escapes by the wound again, and continues to do so in gradually decreasing quantities until the aperture is finally closed, which usually happens at about the end of fourteen or eighteen days ; though in patients who have suffered from phosphatic calculus it sometimes takes a longer period, owing to the broken state of the general health. Should the wound fall into a sloughy state, the patient must be put on a very generous diet, even a free allowance of stimulants : and the tincture of benzoin may be daily applied. When slow of healing, it may be stimulated with nitrate of silver applied to the bottom ; and, should a fistulous aperture be left, that may be touched with the electric cautery. After the operation, appropriate constitutional treatment should be continued for some time in order to prevent a recurrence of the disease.

**Lateral Lithotomy in Boys** under the age of puberty is, perhaps, the most successful of all the great operations in surgery. It is performed much in the same way as in the male adult ; there are, however, some points of modification or of difference in the operation when practised on young-subjects. The following are worthy of note, and should be remembered by the Surgeon in proceeding to operate on children.

1. The urethra in boys will commonly be found larger than would perhaps at first be expected from their age, readily admitting a No. 8 or 9 staff.

2. The perinæum is usually proportionately more vascular in boys, in consequence of the straining produced by the irritation of the calculus.

3. There is often from the same cause a tendency to prolapsus of the rectum.

4. As the prostate is a rudimentary organ in the boy, the deep incision necessarily passes, in most cases, beyond its limits into the neck of the bladder.

5. In boys the tissues are more yielding, and more readily lacerable under the finger.

6. The most important point, however, is, that in the boy the bladder lies high, being rather in the abdomen than in the pelvis; hence, it is of importance to raise the point of the knife somewhat more than in the adult in making the deep incision, and to be careful that it do not slip into the tissues between the rectum and the bladder, which may happen unless this precaution be taken. I have known this to occur in several instances to Hospital Surgeons of skill and experience, the forceps being passed into this space under the supposition of its being the bladder; and in every case the patient died unrelieved. This accident is the more likely to happen, because in boys the parts are very yielding, and readily admit of being pushed before the knife or finger; and the finger may thus pass between the neck of the bladder and the pubes, or into the loose areolar tissue between the rectum and the bladder. The urethra being opened, urine escapes; and the Surgeon introduces his finger into a distinct cavity, which he believes to be the interior of the bladder, but which is not so, but the recto-vesical space. The liability to the occurrence of this distressing and fatal accident is materially lessened by injecting the bladder fully with tepid water, by which it is steadied and brought lower down. But in young boys lithotomy is from this cause always an anxious operation. It falls to the lot of but few Surgeons of experience in lithotomy to pass through an active professional life without meeting with difficulty and anxiety in operating on boys; and when such an untoward accident occurs, those will be the most charitable in their judgment of others, who have themselves had the most experience in the operation and have had most frequently to encounter its intrinsic difficulties.

In order, then, to obviate the special dangers that have just been mentioned as likely to occur in the lateral lithotomy of boys, the following points should be attended to.

1. The bladder should be injected with two or three ounces of tepid water.

2. The point of the knife, when it has entered the groove of the staff, should be kept very firmly pressed against its side, and carried somewhat upwards instead of straight forwards.

3. When the knife is laid aside and the Surgeon proceeds to pass his finger into the bladder, he will find the following manœuvre to facilitate this step of the operation very greatly, and lessen materially the danger of pushing the neck of the bladder before him. Placing the nail of the left index in the groove of the staff, he should not carry it along the convexity of this instrument, but, sliding it over to the concave side, gently but steadily work his way along this into the bladder. In doing so, he passes the finger between the roof of the urethra, which is a fixed part of the canal, and the staff, instead of between this and the floor of the urethra, which is mobile and yielding. There is the additional advantage that, by pressing down the staff as the finger goes above it, the urethra and neck of the bladder are somewhat dilated.

4. So soon as the finger enters the bladder and the staff is withdrawn, the

calculus should be fixed with its point against the floor of the bladder, where it may then be seized easily by the forceps.

DIFFICULTIES DURING LITHOTOMY.—The difficulties before and during the operation are three-fold ; 1, in Finding the Stone ; 2, in Entering the Bladder ; and 3, in Seizing and Extracting the Calculus.

1. **Difficulty in Finding the Stone,** either by the staff or the sound, may exist before commencing the operation ; and sometimes it is impossible to find the stone, although its presence may have been distinctly and incontestably ascertained a few days previously. In these circumstances, the Surgeon must on no account be tempted to proceed with the operation ; but, after a carefully conducted exploration has failed to elicit the actual presence of the stone, all further proceedings must be deferred to another opportunity. The stone may escape detection in three ways. 1. It may have been passed by the urethra, between the first examination and the time fixed for the operation. A small calculus, especially if elongated and spindle-shaped, may give a very distinct click against the sound, and yet be not too large to pass through the urethra. 2. The stone may have become encysted. 3. It may have become enveloped in folds of the mucous membrane of the collapsed bladder, and so may escape contact with the sound. All these events are more likely to happen in children than in the adult, and it is in them that, for want of attention to these precautions, the unfortunate accident of cutting into the bladder and finding no stone has most frequently occurred.

2. **Difficulty in Entering the Bladder.**—This is rarely experienced in adults. It may, however, arise in consequence of the Surgeon neglecting to keep the point of the knife well lodged in the groove of the staff, and thus letting it slip between the rectum and the bladder ; the tissue of which, being broken up, leaves a kind of cavity that he mistakes for the interior of the bladder. If the perinæum be very deep and the prostate enlarged, he may also experience some difficulty in reaching the bladder ; but he can scarcely fail to do so if he push the knife well on in the groove of the staff, and dilate the incision in the prostate with a blunt gorget, if his finger fail to reach the cavity beyond it.

Perhaps the most serious obstacle to entering the bladder consists in the presence of large tumours in the prostate. The combination of a deep perinæum, an enlarged prostate, and a tumour, certainly constitutes a formidable series of obstacles. In these cases, the finger when slipped along the staff does not enter the bladder, but becomes involved in the smooth and irregular sinuosities that wind between the prostatic tumours (Fig. 751). In such cases it is well to practise the manœuvre that has already been described ; viz., of using the staff as a guide into the bladder, slipping the forceps along the side and concavity of this instrument before it is withdrawn.

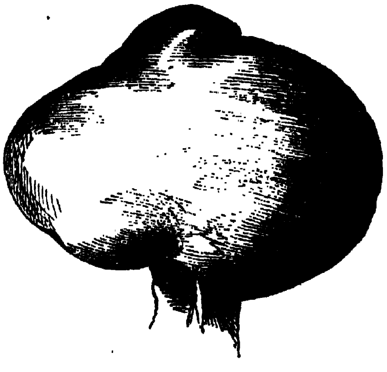


Fig. 751.—Tumour of Prostate, natural size, removed during Lithotomy from a man aged 64.

In *boys*, great and sometimes insuperable difficulty has been experienced in reaching the bladder. This difficulty arises in consequence of the small size of the urethra, the mobility of the bladder, and the ready lacerability of the tissues. If, after the groove in the staff has been exposed, care be not taken to insinuate, as it were, the nail into the opening in the urethra thus made, the membranous portion may be torn across; and the neck of the bladder, receding before the finger, may easily be pushed away from the surface, so that the Surgeon may fail in reaching the cavity of the organ. When the road is once lost in this way, there is the very greatest difficulty in finding it again. The course that should be pursued is, I think, as follows. If the staff have not been withdrawn, the Surgeon must again place the knife in its groove, and carefully push it on towards the neck of the bladder, notching that structure and passing the finger cautiously along the groove, and hooking down the parts with his nail until he reach the inside of the bladder. Should the staff have been withdrawn, the Surgeon must endeavour to pass it again; if he succeed in this, he may act as just stated; but if he cannot succeed in introducing the staff fairly into the bladder, he must on *no account whatever* endeavour to open that viscus, or continue his attempts at the extraction of the calculus, but must at once abandon the operation until the parts have healed, when he can repeat it. The great danger in these cases arises from the Surgeon losing his presence of mind, and endeavouring to enter the bladder without a guide—a procedure which must be unsuccessful, and can only end in the destruction of the patient.

In adults, the difficulty is to get out the stone; in children, to get into the bladder.

3. **Difficulty in Seizing and Extracting the Stone** is far more frequently met with than in reaching the bladder. This may be owing to a variety of causes. It is likely to happen in all those cases in which, either from the depth at which the bladder lies from the surface, or from the peculiar position of the calculus, the stone cannot be felt with the finger after the incisions have been made into the neck of the bladder.

*Difficulty from the Position of the Stone.*—The calculus may be lodged *in the lower fundus.* This is especially apt to happen if the patient be old and fat, and have a deep perinæum, perhaps with enlarged prostate, behind which the stone may be lodged. This constitutes the greatest difficulty. Here the best plan is to use a much-curved pair of forceps, and to tilt the bladder up by introducing the finger into the rectum, so as to bring the stone within reach.

When the stone is situated *in the upper fundus* of the bladder above the pubes, it is altogether out of the axis of the incision, and in such a case can only be extracted with great difficulty. Aston Key recommends that in such cases the abdomen should be compressed, and the calculus thus pushed down into reach. This suggestion is a very useful one; and it was only by employing this manœuvre and using a very curved scoop, that I could remove a calculus lodged above the pubes, in the first patient whom I cut at the Hospital many years ago.

*Difficulty in consequence of the Stone being Fixed to or retained in the Bladder.*—A small calculus may be *enveloped by the folds of the mucous membrane,* and in this way elude the grasp of the forceps. In these circumstances there is nothing for the Surgeon to do, but patiently to try to disentangle and remove the calculus by means of the finger and scoop, if it can be so reached; if not, by expanding the forceps in the bladder, to try to push aside the mucous membrane that surrounds the stone.

In consequence of *spasm of the bladder*, it is said to have occasionally happened that a calculus has been so firmly fixed as not to admit of the application of the forceps, the blades of which could not be introduced between the walls of the viscus without using an improper degree of force, and giving rise to the danger of rupturing the neck of the bladder. I am disposed to think that this "spasm of the bladder" is purely imaginary, and that the real difficulty has arisen from some other cause, as perhaps a contracted and rickety pelvis. But, whatever may be the real cause of a difficulty that has undoubtedly been encountered, I think it would be safer for the Surgeon to desist from the operation, and in the course of a few days or weeks endeavour to complete the extraction, and thus perform the operation "*à deux temps*" of Deschamps.

The stone may be so *fixed between hypertrophied fasciculi* in the interior of the bladder, as to be detached with considerable difficulty. In such cases, the scoop will be found to be the most useful instrument for its removal.

When the calculus is *encysted*, its extraction will probably be impracticable, or attended with most dangerous consequences. Hence, it is expedient not to operate in cases of encysted calculus that are known to be such. If, however, the Surgeon have been unfortunate enough to cut into a bladder containing an encysted calculus, he must be guided in the course he should adopt by the condition in which he finds the stone. If the aperture leading into the cyst be very small, as in Fig. 723, the better plan will be to proceed no further with the operation, as it will be clearly impossible to remove the stone. If, on the other hand, the aperture into the cyst be large, he might feel disposed to make an effort to extract the calculus. With this view he might adopt the plan pursued by Sir B. Brodie in such a case, and endeavour to enlarge the orifice of the cyst by means of a probe-pointed bistoury cautiously applied, and then finish the extraction by means of a scoop. Such a proceeding, however, is in the highest degree hazardous, on account of the readiness with which the section may extend into the peritoneal cavity; as well as difficult in execution, from the depth at which the parts are lying.

I believe that a calculus may occasionally become encysted, or rather encapsuled, in another way,—by being covered in by a kind of false membrane whilst lying on the floor of the bladder. This condition I found in a boy on whom I operated for stone some years ago. After removing a calculus of about the size of a pea, I felt, with the end of the finger, a hard irregular body, covered apparently by mucous membrane, lying at the inferior fundus of the bladder. On scraping through the membrane covering this with the point of my nail and a curved scoop, I exposed the calculus (Fig. 720), and removed it, with a cyst attached to it. On examining the structure of this cyst, which was of about the thickness of ordinary writing paper, of a reddish colour, and resembling a piece of mucous membrane, it was found to be a false membrane, composed of organised fibro-cellular tissue. The patient made a good recovery, with the exception of a slight attack of secondary hæmorrhage, which occurred on the eighth day after the operation.

*Amyloid Tumours in the Prostate* constitute sometimes rather a serious difficulty in lithotomy. They may do this in two ways; first, by elongating the prostatic part of the urethra to so great an extent as to carry the neck of the bladder far from the surface; and, secondly, by being in the way during extraction of the stone. A tumour of this kind, an inch or more in diameter, necessarily fills up to a very serious extent the space in the wound through which the stone has to pass; it jams up the orifice and prevents the free play of the forceps. These tumours, however, when caught between the blades or shanks of the forceps, soon shell out, and, rolling out of the wound, allow the easy exit of the calculus after them (Fig. 751).

*Rickets of the Pelvic Bones* may constitute a serious or even an insuperable obstacle to the extraction of a calculus. This condition may act in two ways. It may narrow the brim of the pelvis in its antero-posterior diameter, to so great an extent as to prevent the passage of the stone downwards after it has been seized by the forceps. This condition is more to be feared in children, in whom the bladder, being an abdominal organ and lying high, is altogether above the brim of the pelvis in these cases. Or there may be difficulty in the extraction of the stone through the inferior outlet, owing to the approximation of the rami on each side. The first cause of difficulty once occurred to me, in operating on a very rickety boy four years and a half old. Of the second I have had no experience. The rickety condition of the pelvis may be suspected in cases in which the lower limbs are much distorted. Its existence may be ascertained by digital exploration of the rectum, and by external measurements. If it be found to exist to an extreme degree, it would probably be safer to perform the suprapubic operation.

*Difficulty depending upon the Shape and Size of the Stone.*—If the stone be very round, it is usually more difficult to seize than when flat or elongated. Flat, disc-shaped calculi, however, occasionally fall into the fundus of the bladder behind the prostate, and then cannot be readily reached by the forceps, which passes over them. In these circumstances, they are best extracted by the curved scoop. Very flat broad calculi, and those that are round, egg-shaped, or branched, are the most difficult to remove, even though their size be not very great. As a general rule, however, it may be stated that, the larger the calculus, the more difficult is its extraction. This arises not so much from the outlet of the pelvis being too narrow, as from the necessity of making the internal incisions through the prostate to a very limited extent. There will always be considerable difficulty experienced in extracting calculi weighing six or eight ounces and upwards; though cases are recorded by Cheselden, Klein, and others, in which calculi from twelve to fifteen ounces in weight have been extracted by the lateral operation. Any calculus above one inch and a half in its shorter diameter will present considerable difficulties in being extracted through an incision in the prostate of the ordinary size; viz., not exceeding eight lines in length, even though this be considerably dilated by the pressure of the fingers; and I think it may be safely said, that a calculus two inches and upwards in diameter can scarcely be removed by the ordinary lateral operation with any degree of force which it is safe to employ. The practice adopted in such a case, more than a century ago, by Gooch, of Norwich, is probably the best that can be pursued. It consists in drawing the stone well down with the forceps, and then letting an assistant carefully divide the tissues that resist. In this way, by a process of traction, twisting, and division, the stone may be brought out with safety. In the facility with which the calculus is extracted, however, much will depend upon the make of the forceps. As Liston most truly observes, "There can be no more fatal error than to attempt the extraction of a large stone with short and shabby forceps." In these cases the open-bladed forceps (Fig. 731) will be found useful, the absence of metal in the most convex part of the blade lessening materially the bulk of the instrument when grasping a stone.

In the event of the calculus being too large to be extracted by the ordinary lateral operation, what course should the Surgeon pursue? Three are open to him: 1. Division of the Right Side of the Prostate from the interior of the wound; 2. Crushing the Calculus in the Bladder, and then removing it; and 3. The performance of the Recto-vesical Operation.

The **Incision of the Right Side of the Prostate** gives considerable additional space, and is sufficient for most ordinary purposes; very large calculi being fortunately seldom met with. This section may be made by introducing into the wound a probe-pointed scalpel (Fig. 730), guided by the index-finger, and very cautiously dividing the right side of the prostate downwards and outwards, in the same direction that the section of the left has been made. This procedure must be cautiously done. The parts, being put well on the stretch as the stone is drawn forwards, are carefully notched, and thus yield to the traction. In two cases I have seen Liston do this. In one the patient recovered, in the other he died of diffuse cellular inflammation. I have practised it once on a patient at the Hospital, who made an excellent recovery.

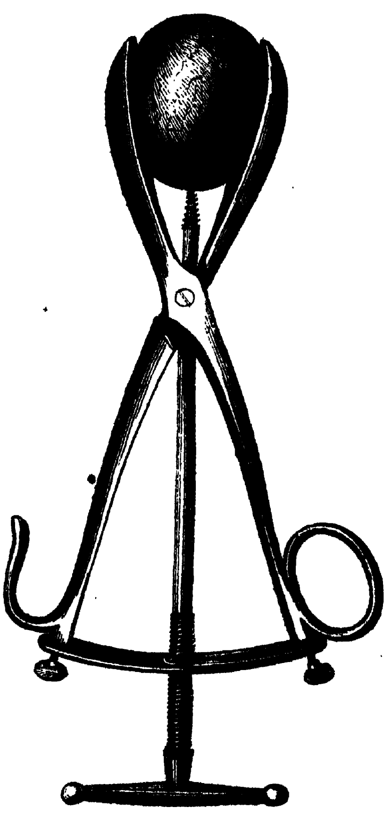


Fig. 752.—Lithotomy Crusher and Drill for large Calculi.

The second plan, that of **Crushing the Calculus in the Bladder** through the wound in the perinæum, would certainly be a hazardous procedure. The irritation that would necessarily be set up by the large lithotrite or crusher (Fig. 752) that has been invented for this purpose, by the presence of the fragments of stone, and by the necessary difficulty and delay of clearing them out of the viscus, would probably be fatal to the patient. In the event of its being impossible to extract the calculus through the perinæum, I think it would be safer to adopt the third course, and to perform the *recto-vesical operation*, which will presently be described. Should, however, the unusually large size of the stone have been recognised before the commencement of the operation, it might be thought more safe to practise at once the high than the lateral operation.

**Difficulty from Fracture of the Calculus.**—The difficulty of extraction is greatly increased if the stone be broken. Fracture of a calculus is of two kinds. In the one case the stone is simply broken into several fragments, or splinters, so to speak, are detached from it. This accident may happen to hard as well as to soft calculi, and is generally owing to the Surgeon employing too much pressure on the blades of the forceps, fearing that the stone may escape from between them ; or it may arise from the large size of the calculus requiring some force to be exercised in its extraction, when the Surgeon is very apt to compress the forceps as he draws the stone down. When this accident is found to have occurred, the Surgeon must remove with small forceps the fragments that have been detached. He should then wash out the bladder by copious injections of tepid water, and very carefully examine its interior for any loose pieces. It is seldom that any worse consequence results from this occurrence, than delay in the completion of the operation.

The second mode of fracture consists in the crumbling down of the calculus so soon as it is seized by the forceps, into a soft mortary mass ; the stone is not broken into large pieces, but, having naturally little cohesion, disintegrates into a mass of softish fragments, none of which probably exceed a cherry-stone in size, and which indeed resemble a wet sabulous aggregation, rather than distinct pieces of calculus. This crumbling down can only occur in phosphatic calculi, and is most likely to happen with the triple phosphate. It is in no way the fault of the Surgeon, but arises from want of cohesion in the calculus, so that the blades of the forceps bite, as it were, through it. It is an unpleasant accident to occur, as it becomes extremely difficult, if not impossible, to clear away the whole of the soft mortary detritus from the interior of the bladder, to the lining membrane of which it tenaciously adheres, small masses lying under the folds into which the contracted organ is thrown. As much as possible should be removed by the scoop, and the remainder washed away, as far as practicable, by copious injections ; with all care, however, some will be left, and may be discharged through the wound some days, or even two or three weeks, after the operation. When this happens, the bladder should be thoroughly washed out every day, or every second day, by warm water injections thrown in through a catheter passed down the urethra and allowed to regurgitate through the wound ; and this plan must be persevered in so long as any foreign body escapes. Should the wound have healed, the detritus must be treated as in lithotrity ; and the bladder must be washed out every second or third day by a large-eyed catheter, until all is removed.

ACCIDENTS DURING LITHOTOMY.—The principal accidents that may occur during the performance of the lateral operation of lithotomy are Hæmorrhage ; Cutting the Bulb ; Missing the Membranous Portion of the Urethra ; Wound of the Rectum ; or Wound of the Posterior Part of the Bladder.

**Hæmorrhage** during lithotomy may occur from three sources :—1. The Superficial Arteries of the Perinæum ; 2. The Deep Arteries of this region ; and, 3. The Prostatic and other Veins. When excessive, from whatever source it proceeds, it is always a very serious complication ; for, even if it do not prove fatal by the induction of syncope, &c., which I believe to be very rarely the case, it is apt to lead to a fatal termination indirectly, and at a later period, by favouring or predisposing to the occurrence of low inflammatory diseases, local or constitutional. I believe that patients who lose a large quantity of blood at the operation seldom recover.

1. Hæmorrhage from the *Division of the Superficial or the Transverse Artery of the Perinæum* is seldom very dangerous, though occasionally, if these vessels be larger than usual, they may furnish a serious quantity of blood ; in such circumstances their ligature would be required, and might be practised either before or after the extraction of the calculus. It is better, if possible, to wait until the completion of the operation, lest the ligature be pulled off during the extraction of the stone.

2. The *Division of the Deep Arteries* of the perinæum, that of the bulb and the internal pudic, would be attended by far more serious, perhaps even by fatal consequences ; as, from the depth at which the vessels are seated, it would almost be impossible to apply a ligature to them, unless the patient were very thin, and the perinæum proportionately shallow. The facility of ligaturing any of these arteries, especially that of the bulb, when wounded, is greatly increased by enlarging the incision upwards. In the event of a ligature not being applicable, the Surgeon would have to trust to plugging the wound around the tube, or to the pressure of an assistant's fingers continued for a considerable time. The pressure of the fingers of relays of assistants, kept up for a considerable length of time, is perhaps the surest mode of arresting the hæmorrhage. The pressure must be kept up for many hours ; thus South relates a case in which it was maintained for fourteen hours ; and Brodie one in which, after twenty-four hours, it succeeded. The assistants should not be changed more frequently than necessary, each keeping up pressure for two or three hours, and removing his fingers as cautiously as possible. It is, doubtless, very rare for these arteries to be wounded when they follow their usual course ; though such accidents have happened in the hands of some of the most skilful lithotomists, such as Home, Bell, Roux, and Desault. It was the opinion of Aston Key that the artery of the bulb was generally cut during lithotomy ; but in this I believe he was mistaken, so far as its trunk is concerned, though doubtless in many cases the bulb itself may be wounded, and the mesh of twigs, in which the vessel terminates, divided ; this, however, would not yield an alarming hæmorrhage. The trunk of the artery of the bulb would, however, be endangered by opening the urethra too high up, and lateralising the knife too early, and might bleed very freely.

The internal pudic artery, bound down by a strong fascia and under cover of the ramus of the ischium, runs but little risk unless the knife be lateralised too much, and the incision be carried too far outwards. It is in some of the anomalous distributions of these vessels that the greatest danger would be occasioned. The artery of the bulb, the inferior hæmorrhoidal, the dorsal artery of the penis, or the internal pudic, may take such an anomalous course that their division must be inevitable ; and, as the Surgeon has no possible means of knowing beforehand whether the distribution of the arteries is regular or not, and as his incisions are all planned on the supposition that they are, he is not to blame in the event of a vessel being accidentally divided, when it takes an abnormal direction, with which it is impossible to be acquainted until after the accident has occurred.

If the incision be commenced too high up, and especially if the upper part of the first incision be made by pushing the knife in too deeply, the corpus cavernosum and its vessels may be wounded.

It may be stated as a general rule, that serious hæmorrhage is usually best avoided by making the incisions low; and indeed, I believe that the great secret of success in the lateral operation of lithotomy consists in making all the deep incisions as low as practicable; the knife entering the groove of the staff from below upwards, rather than from above downwards.

3. *Venous Hæmorrhage* may occur from two sources—the superficial or the prostatic veins. It is very seldom that any trouble arises from superficial veins; but in one case I have seen very considerable loss of blood occur from a large vein running transversely to and near the upper angle of the wound, lying almost immediately under the skin, which had been incompletely divided. From the prostatic plexus hæmorrhage is most likely to occur in old people, in whom the veins in this situation are often enlarged—almost hæmorrhoidal.

Whether the venous bleeding take place from a superficial or from a deep source, it is very apt to find its way back into the bladder, to mix with the urine, and thus to escape through the tube rather than from the wound itself; or the blood may probably coagulate in the interior of the bladder, distending that organ and producing a feeling of dysuria. Should it proceed from a superficial source, it may be necessary, as was done in the case just alluded to, to pass a ligature under the vessel, and thus arrest it. If it occur from the prostatic veins, the better plan will be to plug the wound. This is done by passing long strips of lint, either dry or soaked in a solution of perchloride of iron or of alum, along the side of the tube, which must be left in the wound and kept pervious; or the lithotomy tube may have a "petticoat" of thick muslin tied around it, into which the slips of lint are stuffed. The advantage of this arrangement is, that the whole apparatus may very easily be removed together at the end of forty-eight hours.

Hæmorrhage from any of the above-named sources, but more especially from the deep arteries and veins, may take place into the bladder. When this occurs, the urine that escapes will be seen to be deeply mixed with blood, and coagula will form in the interior of the viscus, which becomes distended and rises above the pubes, with dulness on percussion in the hypogastric region. The patient will become pale, faint, and cold. In such circumstances, the coagula must be washed out of the bladder with cold water, the source of hæmorrhage ascertained by an examination of the wound. the further flow of blood arrested by plugging, the ligature, or the actual cautery, restoratives administered, the pelvis placed high, and the patient keep cool.

**Wound of the Bulb** is not of very uncommon occurrence in lithotomy; and, I believe, is of no consequence beyond furnishing a small additional quantity of blood. Indeed, the bulb is so situated, in many cases overlapping the membranous portion of the urethra, that this can scarcely be opened without wounding it.

**Missing the Urethra** altogether, and opening up the bladder through or even altogether beyond the prostate, is an accident that may happen if the Surgeon miscalculate the depth of the perinæum, and, keeping the incisions too low, thrust the knife too deeply. It is, I believe, an inevitably fatal accident, as in it the base of the bladder and the recto-vesical fascia are opened, and the patient is thus exposed to the occurrence of diffuse inflammation of, and infiltration into, the pelvic fasciæ. I was present many years ago at the *post mortem* examination of a fatal case of lithotomy, in which perhaps the most skilful operator of that day had opened the bladder beyond the prostate, leaving the urethra untouched ; the patient died from the cause just stated.

**Wound of the Rectum** occurs more frequently than is generally supposed. It may happen either in consequence of the staff being too much depressed, the edge of the knife turned too directly downwards, or to the rectum being distended and overlapping the sides of the prostate. I have also known the lower part of the rectum perforated by the Surgeon's finger, whilst depressing the gut so as to keep it out of the way of the knife. The *Treatment* of this accident will vary according to the size and situation of the aperture. If it be of but moderate extent and low down, just above the anus, it will probably close as the wound granulates and the urine resumes its passage through the urethra. If the incision be more extensive and higher up, the patient will incur the risk of the miserable infirmity of recto-vesical fistula being induced. In such circumstances, the proper treatment is to divide the sphincter ani from the opening downwards, and thus to lay the gut and wound into one cavity which will probably fill by granulation, and thus close the urinary passages.

**Wound of the Posterior Part of the Bladder** is very rare ; yet it has happened in consequence of the knife being thrust too deeply along the groove of the staff, more particularly in operations on children, and would be specially apt to happen in such cases if the bladder did not contain sufficient urine at the time. This is an additional reason for injecting the bladder before operating.

In *children*, the lateral operation of lithotomy presents certain special difficulties which have already been adverted to. These are : 1, the Surgeon missing the bladder and opening up the recto-vesical space (p. 780) ; 2, not opening the urethra and neck of the bladder sufficiently with the knife, but pushing these parts before the finger, and so tearing across the urethra, and thus necessarily being unable to complete the operation (p. 782) ; and 3, running the knife too far along the groove of the staff into the bladder, and thus wounding the posterior part of that organ.

SOURCES OF DANGER AND CAUSES OF DEATH AFTER LITHOTOMY.—Lithotomy, even in healthy subjects, is always a dangerous operation ; and, though the rate of mortality doubtless depends greatly upon the dexterity and skill of the operator, more is, I believe, due to the constitution and age of the patient, and especially to the state of his kidneys. Sir B. Brodie most justly says, "Success in lithotomy most undoubtedly depends in a great degree on the manual skill of the Surgeon, and on the mode in which the operation is performed ; but it depends still more on the condition of the patient with respect to his general health, especially on the existence or non-existence of organic disease." That the mere cutting into the bladder is not a very dangerous proceeding, provided that viscus and the kidneys be healthy, is evident from the fact that, in those cases in which Surgeons have had to extract bullets, bits of catheter, &c., from this organ, bad consequences have rarely occurred, though the operations have often been tedious. In lithotomy the case is different; for here the bladder is not only usually in a state of chronic irritation, but the kidneys are frequently diseased, and these conditions influence the result of the operation more materially than any other circumstances. Hence an operator may have a run of unsuccessful cases; or, by a fortunate concurrence of favourable cases, more particularly in children, it has occasionally happened that a Surgeon has cut 20 or 30 patients in succession without losing a single one; but several deaths then occurring, though the operation was performed in the same way and with the same care as before, his average has fallen to about the usual level. Green, at St. Thomas's, cut 40 patients in succession, and only lost one. Lynn cut 25 patients for stone without losing one, and he said that he thought he had at last discovered the secret of performing lithotomy with success; but, he added, the Almighty punished him for his presumption, for he lost the next 4 cases that he cut. Bransby Cooper, of Guy's, cut 30 patients in succession without a death, but then lost several, thus reducing the rate of mortality to the usual standard. Liston, during a period of six years, in which he operated 24 times, lost no patient from lithotomy at University College Hospital; but out of the whole 37 cases which he cut during the period of his connection with that institution, there were 5 deaths; reducing the average to 1 in 7·2. This success was, however, very great when it is taken into consideration that most of these cases occurred in adults, and that many of them were of a very serious character. I find on reference to the Hospital Records, that only seven of the patients were under 10 years of age, whilst 14 were above 50; of these, two were 80 years of age, of whom 1 died and the other recovered. I believe that Liston lost only one patient under 60 years of age, and that was a lad of 18, in whom he found it necessary to divide the right side of the prostate as well as the left, and who died of infiltration of urine. Thirty-eight patients, successively operated on at the Norwich Hospital, recovered, but the average rate of mortality in that Institution, calculated from 871 cases, has been 1 in 7·50.

The accompanying Table gives much valuable information on the rate of mortality after lateral lithotomy at different ages. It may be taken as a fair example of successful English practice in this operation.

TABLE OF PATIENTS ON WHOM LATERAL LITHOTOMY WAS PERFORMED AT THE NORFOLK AND NORWICH HOSPITAL FROM JANUARY, 1772, TO DECEMBER, 1869. BY CHARLES WILLIAMS, F.R.C.S., ASSISTANT SURGEON TO THE HOSPITAL.

| Age of Patients Operated upon. | No. of Cases. | Per centage of the whole number. | Recoveries. | Per centage of Recoveries. | Deaths. | Per centage fatal. | Proportion fatal. | No. of Cases. | Per centage of the whole number. | Recoveries. | Per centage of Recoveries. | Deaths. | Per centage fatal. | Proportion fatal. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 to 5 | 185 | 21·23 | 169 | 91·36 | 16 | 8·64 | 1 in 11·56 | 335 | 38·46 | 314 | 93·74 | 21 | 6·26 | 1 in 15·95 |
| 5 ,, 10 | 150 | 17·22 | 145 | 96·6 | 5 | 3·4 | 1 ,, 30 | | | | | | | |
| 10 ,, 15 | 78 | 8·38 | 66 | 90·41 | 7 | 9·59 | 1 ,, 10·42 | 113 | 12·97 | 100 | 88·50 | 13 | 11·50 | 1 ,, 8·69 |
| 15 ,, 20 | 40 | 4·59 | 34 | 85 | 6 | 15 | 1 ,, 6·6 | | | | | | | |
| 20 ,, 30 | 51 | 5·85 | 46 | 90·20 | 5 | 9·80 | 1 ,, 10·2 | 103 | 11·82 | 93 | 90·30 | 10 | 9·70 | 1 ,, 10·3 |
| 30 ,, 40 | 52 | 5·97 | 47 | 90·39 | 5 | 9·61 | 1 ,, 10·4 | | | | | | | |
| 40 ,, 50 | 58 | 6·65 | 44 | 75·87 | 14 | 24·13 | 1 ,, 4·14 | 178 | 20·44 | 142 | 79·77 | 36 | 30·23 | 1 ,, 4·94 |
| 50 ,, 60 | 120 | 13·89 | 98 | 81.7 | 22 | 18·3 | 1 ,, 5·45 | | | | | | | |
| 60 ,, 70 | 119 | 13·66 | 90 | 75·43 | 29 | 24·57 | 1 ,, 4·06 | 142 | 16·30 | 106 | 74·55 | 36 | 25·45 | 1 ,, 3·94 |
| 70 ,, 80 | 23 | 2·64 | 16 | 70·84 | 7 | 29·16 | 1 ,, 3·42 | | | | | | | |
| Total | 871 | | 755 | 86·68 | 116 | 13·32 | 1 in 7·50 | 871 | | 755 | 86·68 | 116 | 13·32 | 1 in 7·50 |

Cheselden only lost 1 in every 10¾; and, according to South, at St Thomas's the mortality has not amounted to more than 1 in 9¾; but a good many of these patients were probably children. Sir B. Brodie states, that of the 59 cases operated on in all the London Hospitals in the year 1854, 10 died; making the mortality as nearly as possible 1 in 6. But the more recent and extended statistics collected by Thompson, show that the average mortality in the London Hospitals is 1 in 7¼. According to Coulson the average mortality in England, deduced from 1743 cases of the lateral operation, is 1 in 6·93 cases; whilst in France it is 1 in 5·7; and for Europe generally 1 in 5·14. The more recent statistics of Sir H. Thompson show a more favourable result for lateral lithotomy in England. He finds that out of 1827 recorded cases there were 229 deaths, or nearly as possible 1 in 8. Klein states that, of 4486 cases of lateral lithotomy, in Moscow, there were 552 deaths; the mortality thus being nearly the same as in England.

The per-centage of deaths after lithotomy in the adult will doubtless be found gradually to increase with the increasing use of lithotrity. This must not be referred to any defect in the method, or to want of skill in the performance of lithotomy, but to the fact that, instead of, as heretofore, being the general method of removing calculus, it has now become the exceptional one. Almost all cases of small and moderate sized calculi in men with otherwise healthy urinary organs are now subjected to lithotrity, whilst those cases in which the stone is too large, or the kidneys, bladder, prostate, or urethra too diseased, to admit of this mode of operating, are reserved for lithotomy; and as the mortality after this operation increases in the exact proportion to the size of the stone and the disease in the urinary organs, we must expect that, when its performance is confined to persons with large calculi, irritable bladders, enlarged prostates, diseased kidneys, or strictured urethræ, a higher per-centage of deaths will follow it than was the case when all favourable cases, and not the unfavourable ones only, were subjected to it.

**Age** exercises a more marked influence on the result of lithotomy than any other condition. Lithotomy may be looked upon as one of the most successful operations in surgery at early periods of life, a hazardous one in middle age, and an extremely dangerous one in advanced age. At the Norwich Hospital, lithotomy has been found to be four times as fatal in men as in boys. Coulson finds, on analysing 2972 cases of lithotomy, that the mortality at each successive decennial period is as follows. Below 10 years it is 1 in 13, and thence gradually augments from 10 to 80 years to 1 in 9, 1 in 6, 1 in 5, 1 in 4, 1 in 3·65, 1 in 3·23, and 1 in 2·71.

The reason of the small mortality after lithotomy in boys, as compared with adults, is twofold. In the first place, the urinary organs, more especially the kidneys, are healthier than in the adult; and secondly, the urine is less acrid, less irritating, less loaded with effete materials of an unhealthy character, and is consequently less apt to excite inflammation in those tissues over which it filtrates in its passage through the wound.

Hence, when boys die after lithotomy, they do not usually perish from the same causes that prove fatal in the adult, viz., kidney-disease and diffuse pelvic inflammation and infiltration; but the fatal result is generally the consequence of some accident having occurred or violence been inflicted during the operation, such as by mistaking the recto-vesical space for the interior of the bladder, the tearing across of the urethra and non-extraction of the stone, wounding of the recto-vesical fold of peritoneum, or perforation of the back of the bladder by the point of the scalpel. It is by these accidents usually that death happens in boys that are cut for stone, and not from unavoidable circumstances that may follow the most skilfully performed operation.

The **Shock of the Operation** occasionally proves fatal, though probably much less frequently since the introduction of chloroform than was formerly the case. Yet, even now, patients occasionally die from this cause, induced either by a very much prolonged operation, or by the system being weakened, and having lost its resisting power in consequence of disease of the kidneys, perhaps of a latent character.

The **State of the Kidneys** influences the result of lithotomy in the adult more directly than any other condition. If these organs be sound, the patient will usually recover ; hence in children, in whom the complication of renal disease rarely exists, lithotomy is very successful, even though the operation is proportionately far more severe in them than in adults. If, on the other hand, the kidneys be extensively and chronically diseased, the patient will commonly die, even though he have been operated upon with the utmost care and skill. The condition of the kidneys that is especially fatal has been fully described in Chapter LXVII. This morbid condition may be evidenced by the presence of albumen in considerable quantities in the urine, and granular casts, with muco-pus. If the albumen, in subsiding to the bottom of a test-tube, after being coagulated by heat and acid, form a precipitate that does not amount to more than one-tenth of the bulk of the urine, the case may, I think, be looked upon as tolerably favourable ; but, if it amount to one-sixth, the case is decidedly unfavourable, though even under these circumstances I have often seen recovery take place. Yet, with kidney-disease that will furnish such a quantity of albumen as this, the patient will be very liable to the occurrence of low and diffuse cellular inflammation.

A **Prolonged Operation**, even under anæsthetics, is dangerous ; and, although it is certainly not well to operate against time, yet it is undoubtedly advantageous to finish the operation with as little delay as is consistent with the safety of the patient, even though he be anæsthetised.

**Hæmorrhage** does not so often prove fatal, either shortly after the operation, or at a later period, as might be expected from the great vascularity of the parts incised. Secondary hæmorrhage, of a dangerous or even fatal character, may, however, come on six, eight, or ten days after the operation. I have known it as late as the fourteenth day. It must be borne in mind that, when hæmorrhage takes place after the operation, the blood may find its way into the bladder rather than escape externally, distending the viscus with coagula, but not giving any external evidence of the mischief that has occurred. Secondary hæmorrhage will usually cease on plugging the wound with sponge or lint soaked in alum solutions. Should it prove serious, however, the actual cautery may be advantageously employed. In a case that occurred to me, the bleeding on the ninth day was stopped by wiping out the wound with the actual cautery, a practice which, I have been informed by A. Dalrymple, was occasionally successfully practised by that excellent lithotomist, his father.

**Cystitis** is, in my experience, a rare sequence of lithotomy. I have, however, seen it occur, attended by the secretion of large quantities of viscid, ropy mucus from the bladder, coming away two or three days after the operation, with tenderness in the suprapubic region. It may exist before the operation, or may be developed by long-continued or rough manipulations with the forceps in searching for the stone, or from the irritation of the tube. The symptoms are apt to simulate those of pelvic peritonitis. The *Treatment* consists of fomentations above the pubes, abundant diluents, and washing out the bladder with tepid water injected through the wound.

**Diffuse Inflammation of the Areolar Tissue of the Pelvis**, especially of the layers around the neck of the bladder, between it and the rectum, and that extend from thence under the peritoneum, is the most frequent cause of death after lithotomy. This inflammation, which is always diffuse or erysipelatous, followed by rapid sloughing of the textures that it invades, may arise from two causes: 1. From the urine being *infiltrated into the areolar tissue*, in consequence of the incision extending beyond the limits of the prostate, into the loose layers of tissue that lie behind the recto-vesical fascia and around the bladder; 2. In consequence of the *bruising and laceration* to which the neck of the bladder, the prostate, and the textures between it and the rectum, are subjected, in prolonged attempts to extract a large calculus through too small an incision.

1. The danger of *Cutting beyond the Limits of the Prostate* in the adult has already been adverted to. In the extraction of calculi of ordinary size, there can be no necessity to extend the internal incision; but when the calculus is of considerable magnitude, the Surgeon, wishing to get as much space as possible, may inadvertently carry his knife beyond the prostate; or, if he make a cut into the right side of this gland, he may perhaps prolong it a little too far, and thus open the loose areolar tissue or fascia which lies beyond it, and which is continuous with the pelvic and subperitoneal planes of areolar membrane. By dilating the incision in the prostate downwards and outwards, either with the finger or with a blunt gorget, injury to this tissue is prevented.

If the incision extend beyond the prostate, the urine, as it escapes through the wound, soaks into the meshes of the loose areolar tissue over which it flows, and thus gives rise to infiltration, followed by rapidly extending inflammation and sloughing, which speedily involve the whole of the neighbouring textures. This mischief generally occurs within the first forty-eight hours; indeed, I have never seen it come on after the third day. It is indicated by the patient being seized with rigors, followed by dry heat of skin, a quick pulse, which, after a time, may become intermittent, and a dry and brown tongue. At the same time he will complain of some tenderness about the lower part of the abdomen, and in the groins; the belly becomes tympanitic, the body covered with a profuse sweat; hiccup comes on, the pulse becomes more weak and fluttering, and death usually occurs about the fourth or fifth day after the operation. In some cases, there are more decided signs of peritoneal inflammation; but, as Brodie very truly remarks, this is not the primary disease, but is only induced secondarily by the inflammation and sloughing of the areolar tissue of the pelvis spreading to the contiguous serous membrane.

The *Treatment* of such cases must be conducted on the ordinary principles that guide us in the management of diffuse inflammations. It is only by administering ammonia, with such a quantity of wine or brandy as the state of the system may indicate, together with such nourishment as the patient can take, that life can be preserved. The disease is a depressing one, and requires a stimulating plan of treatment. Brodie has recommended that in these cases a free incision should be made through the sloughy tissues about the wound into the rectum, in accordance with the general principles that guide us in the management of similar affections elsewhere. In one case of that kind that occurred under his care, he saved the patient by passing a curved probe-pointed bistoury into the wound to its furthest extremity, to the left side of the neck of the bladder; he then pushed it through the tunics of the rectum, and, drawing it downwards, divided the lower part of the gut together with the sphincter; thus laying the wound and the rectum into one. The relief was immediate, and the patient recovered. This plan of treatment certainly seems rational, and worthy of trial in similar cases.

2. Diffuse inflammation of the areolar tissue around the neck of the bladder and prostate arising from *Bruising and Over-distension* of the parts during the extraction of a large calculus is, I believe, a more frequent occurrence than infiltration of urine, and fully as fatal. This sequence of lithotomy is especially apt to occur in those cases in which, in consequence of diseased kidneys, or the existence of other organic mischief, the patient is more than usually liable to the supervention of diffuse or erysipelatous inflammation; indeed, it is in this indirect way, I believe, that diseased kidneys constitute such a formidable obstacle to the safe performance of lithotomy.

In the extraction of large calculi, considerable traction is required, and force must be exerted; hence undue bruising and laceration are very apt to be inflicted upon the parts that constitute the line of incision. It is in this way that the danger of lithotomy increases almost in exact proportion to the size of the calculus: for here the Surgeon is often placed between the horns of a dilemma. He must either cut beyond the limits of the prostate, and thus incur the risk of inducing urinary infiltration into, or diffuse inflammation of, the pelvic fasciæ: or else, by limiting his incision to the margin of the gland, and thus having, perhaps, an aperture of insufficient size, he may inflict severe injury by the bruising and laceration of parts during forcible and possibly prolonged efforts at extraction. It must, however, be borne in mind that, the larger the stone, the more probability is there of the existence of old-standing disease of the bladder or kidneys, and of an unfavourable result from this cause. Crosse has drawn up a table that shows very strikingly the influence of the weight or, in other words, of the size of a calculus on the results of lithotomy. He found that when the stone was one ounce and under in weight, the deaths were in the proportion of 1 in 11·25 cases. When it was from 1 to 2 ounces in weight, there was 1 death in 6·61 cases: when from 2 to 3 ounces, 1 death in 2·18 cases: when from 3 to 4 ounces, 1 death in 1·57 cases: when from 4 to 5 ounces, 1 death in 1·66 cases. This table, which has been constructed on the results of 703 cases, illustrates very clearly these facts, that the operation for the removal of a large calculus is far more dangerous than that for the extraction of a small one, and that the danger increases in the direct ratio of the size of the stone.

The symptoms of diffuse inflammation of the areolar tissue arising from this cause very closely resemble those from infiltration of urine, and the treatment must be conducted on precisely similar principles.

**Peritonitis** may occur after lithotomy, as a consequence of the extension of inflammation from the bladder or the pelvic fasciæ to the serous membrane, from wound of the posterior part of the bladder, or from extension of inflammation from a sacculus of the bladder to its immediate investment of peritoneum. To one or other of these conditions, more especially inflammation of the pelvic fasciæ, it will always be found to be secondary.

**Sloughing.**—In persons of a feeble and cachectic habit, especially in those who are the subjects of phosphatic calculi, the wound will often assume a sloughy condition, and heal slowly, or its surface may become coated by phosphates. In such cases a liberal allowance of stimulants will be required, together with the local application of compound tincture of benzoin ; and, in order to facilitate contraction at a more remote period, a solution of nitrate of silver, or the tincture of cantharides. The phosphates may be removed by injection of the dilute nitric acid lotion.

Having finished the consideration of the ordinary lateral operation, we shall now proceed to that of other methods for extracting the stone by cutting procedures. These are the *Median*, the *Bilateral*, the *Medio-lateral*, and the *Suprapubic* operations ; each of which has its advocates, to the exclusion of the others, and each of which undoubtedly possesses certain special advantages. In addition to these, there are various modifications of these different operations which the ingenuity of Surgeons has devised, but which have usually little to recommend them in the opinions of any except of their originators.

MEDIAN LITHOTOMY.—The *median operation* of lithotomy is that procedure by which a stone is extracted through an incision in the raphe of the perinæum, extending into the urethra behind the bulb.

*History.*—The history of the median operation affords an illustration of the mutability of professional practice, and makes it appear as if there were a cycle of opinion in surgery, as in fashion, politics, and philosophy. The median operation was introduced three or four hundred years ago, and continued to be practised up to the middle of the last century, when its tediousness, its painful character, and the excessive mortality following it, caused it to fall into disuse as soon as the safer and simpler method of Cheselden was introduced. Of late years, however, it has been revived under a somewhat modified form ; and it is this modern median operation, and its supposed advantages over the lateral, that we must here consider.

The old median operation—called also the "Marian," from Sanctus Marianus, who wrote on it, though it did not originate with him, and the "operation of the apparatus major," from the number of instruments used in it—was performed in the following manner, according to John Bell. A grooved staff was introduced into the bladder, and the patient tied up in the usual way; the lithotomist then, kneeling or sitting before him, made an incision in the perinæum, not exactly in the raphe, which was thought to be dangerous, but very slightly to the left side, and terminating just above the anus. The knife was then carried on to the membranous part of the urethra, which was opened on the groove of the staff; and, the knife being kept firmly pressed against the staff, a long probe was introduced into the bladder by its side. The knife and the staff were now withdrawn, nothing but the probe being left in the bladder, to serve as a guide into this cavity. Along this probe, two iron rods, called "conductors," were now passed, and with these the operator dilated the prostate and neck of the bladder, by separating the handles—at least, it was said that he dilated them, but, as John Bell pithily observes, "he dilated, or, in plain language, tore open, the prostate gland." These conductors being held aside, "dilators" were introduced so as to enlarge the opening, the forceps was then pushed into the bladder, and the stone extracted as it best could be.

The principles of this operation were—a limited incision in the membranous part of the urethra above the anus; dilatation, and not incision, of the prostate and neck of the bladder; or, to use the words of Le Cat, "small incision; much dilatation."

Its results were, however, so unsuccessful, that it fell into entire disuse here, and almost so on the continent, merely appearing from time to time under various modifications at one or other of the continental schools. This condition of things prevailed until about twenty years ago, when a new form of median operation was devised by Allarton, who with great perseverance and equal ability urged it upon the attention of Surgeons in this country, by whom it has now been extensively practised.

**Operation.**—This operation, for the introduction of which into modern surgery the greatest credit is due to Allarton, is performed as follows. A staff, grooved along its convexity, having been inserted into the bladder, the patient is tied up in the usual manner; the Surgeon then, sitting in front, introduces his left index finger into the rectum, and feels for the apex of the prostate, against which he keeps it lodged, in order to judge of the distance of the prostate from the surface, to act as a guide to the knife, and prevent the rectum from being wounded. A straight-backed bistoury is now entered half an inch above the anal aperture, and pushed straight forwards, to a depth of about an inch and a half in the mesial line, so as to enter, if possible, the groove of the staff at the apex of the prostate. A small incision upwards is then made in the groove of the staff, and, as the knife is withdrawn, the incision in the skin is also extended upwards; the knife is then laid aside, and a long ball-pointed probe is introduced into the bladder along the groove of the staff, which is then withdrawn. The probe is now the only guide to the bladder; and up to this point, therefore, there is but little, if any, difference between the modern median and the old Marian operations, except that the incision is exactly in, instead of a little to one side of, the middle line. The forefinger is now introduced along the probe, and by working it forwards the prostate is dilated, and the finger enters the bladder, when, the probe being removed, the forceps is introduced, and the stone extracted. Thus it will be seen that the only real point of difference between this and the old Marian operation, is that in the modern median the finger is used as the dilator, whilst in the Marian the prostate and neck of the bladder were forcibly expanded or torn open by the use of instruments; a difference, however, of no slight moment.

I have found it advantageous to modify this operation in one or two points. The first, which I think of some utility, is to use, instead of the ordinary curved staff, a rectangular one grooved from about one inch above the elbow nearly to the point, resembling the staff introduced by Buchanan of Glasgow (Fig. 753). Its use and advantages are that, when in the bladder, the angle rests against the apex of the prostate, and can be felt in the perinæum, and the Surgeon can judge of the exact point where to enter the knife (directing it so as to open the groove just below the angle), which he cannot do with the curved staff; the incision upwards also is limited, and there is, besides, less danger of wounding the rectum, the urethra being drawn upwards away from it, and not pushed down against it, as with the ordinary staff. The knife should be straight-backed, having the back not more than two inches long; so that the Surgeon can tell to what depth he has entered it. I have found it advantageous in practice to carry a beaked director, shaped like a large hernia-director, along the groove, after the incision has been made in the urethra, so as to open up the canal and thus to clear the passage for the finger. And having opened the urethra, I think it better to dilate the prostate before withdrawing the staff; by pushing the finger slowly, with a rotatory movement, along its side, the bladder is entered with more ease and certainty; whereas, if only the probe be used, it may not be stiff enough, and the Surgeon is apt to push the bladder before him. It has been proposed to employ mechanical means of dilatation, instead of the finger, to open up the prostate and neck of the bladder; and I have had some dilators for this purpose constructed by Coxeter on the principle of the two-bladed dilator of the female urethra. I have tried them on the dead subject; but I have not ventured to use them on the living, lest, by the employment of screw-power, the same deep lacerations of the neck of the bladder should result that were so fatal in the old Marian operation. Indeed, I believe that their use would be fraught with danger from their liability to occasion rupture of the neck of the bladder; and, if persisted in, I cannot but fear that they will bring discredit on the operation, reducing it to the condition of an old Marian, and repeating the dangers of that procedure. No safe dilatation can be effected except by the finger, with which no harm can be done, whilst it appears to me that the greatest possible mischief may be done with screw-dilators.

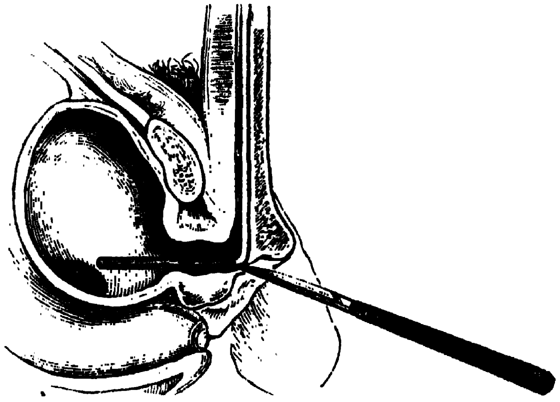


Fig. 753.—Median Operation with Rectangular Staff.

**Comparison between the Median and the Lateral Operations.**—The two operations, the lateral and the median, cannot with propriety be compared as a whole, as we have as yet no sufficient statistics to enable us to determine whether the mortality after the median has been less than that which has followed the lateral. We may, however, compare the modern median operation with the lateral, and endeavour to determine in what respects the median is superior, in what inferior, to the lateral, and in what cases it might be employed instead of the latter. For in this, as in lithotrity, the Surgeon should not be too exclusive ; it is his duty to learn and to practise different methods of attaining the same end, and to make use of one or the other according to the requirements of the actual case before him, and to endeavour to select what is good and to reject what is doubtful in every method brought before him. It would be in the highest degree unsurgical to lithotrise only, or to cut only, every patient with stone coming under care ; and I believe that there is a choice as to the cutting operation to be performed. In fact, there are no operations in Surgery that require to be so frequently modified, according to the necessities of the particular case, as those for stone : the age of the patient, the size and number of the calculi, and the condition of the urinary organs, all exercise very important modifying influences, and prevent the Surgeon from confining himself to one method exclusively.

In order to make a proper comparison between these two operations—the median and the lateral—we must take them *seriatim*. The difficulties and dangers of the lateral operation are : 1, the difficulty in some cases of entering the bladder ; 2, hæmorrhage ; 3, the risk of wounding the bulb ; 4, of wounding the rectum ; 5, too extensive an incision in the prostate, and opening up the pelvic fascia ; 6, the difficulty in extracting the stone.

1. **General Ease and Simplicity of the Operation.**—There is no doubt that the Surgeon will be more skilful in that operation which he has more often performed : so far as ease and simplicity are concerned, there is no great difference between them. In the lateral operation there is very seldom any difficulty in entering the bladder, though Surgeons have sometimes been foiled in this ; but Surgeons of the greatest skill have also had great difficulty in entering the bladder in the median operation. The bladder tends to be pushed upwards and backwards before the finger, especially in boys, in whom the prostate is not developed ; and, unless the neck of the bladder be well opened, there appears to be great danger of tearing across the membranous part of the urethra, and of pushing forward the separated bladder. In boys, the parts are so very small and undeveloped, and the space to work in is so very narrow, that an ordinary finger can only with great difficulty be got through the neck of the bladder unless this have been freely incised. But, by doing this, we depart entirely from the guiding principle laid down by the advocates of the median operation, viz., dilatation and not incision. So far as facility of entering the bladder is concerned, the two operations are probably on a par in the adult : but in the boy the result of recent experience would show that the difficulties in this respect are far greater in the median than in the lateral ; although the latter operation even is not exempt from difficulty from this cause.

2. **Hæmorrhage.**—In this respect, the median operation has decidedly the advantage. If the incision be made in the middle line, without wounding the bulb, although there may be tolerably free bleeding at the time, yet there is no vessel that can furnish dangerous consecutive hæmorrhage ; whilst in the lateral

operation there are the dangers of arterial and of profuse venous hæmorrhage, the knife coming into close relation with the artery of the bulb and others of some size. If the object were, therefore, simply to save blood, the median is so far better than the lateral. But, after all, it must in fairness be said that the danger of excessive hæmorrhage in the lateral operation is but very small. With care, it will rarely happen that the patient loses a dangerous amount of blood.

3. **Wound of the Bulb.**—This may occur in both, but is more difficult to avoid, and indeed is very likely to happen, in the median, as the bulb sometimes so overlaps the membranous part of the urethra, that it is difficult not to cut it; whilst in the lateral operation, by cutting low down, and entering the groove of the staff well back, and from below upwards, this may always be avoided. It is true that division of the bulb in the mesial line seldom gives rise to much hæmorrhage; but cases have occurred to my knowledge, though not in my practice, in which patients have died from this cause after the perineal section, the blood regurgitating into the bladder, and filling that viscus.

4. **Wound of the Rectum.**—This gut is not in much danger in the lateral operation, unless it be distended. In the median, on the other hand, the rectum is in considerable danger. If this operation be performed on the dead body, it will be found that the back of the bistoury comes very, I may say uncomfortably, close to the finger in the rectum; and if another finger be placed in the wound, they will come into very close apposition just anterior to the prostate. In the old Marian operation, the rectum used to be very frequently cut, gas and fæces issuing from the wound.

5. **Treatment of the Prostate.**—As to the difference in this respect—*i.e.*, dilatation in the median, section in the lateral operation—I believe it to be more imaginary than real. I think that it is very nearly the same in both operations when properly performed. All are agreed that in the lateral operation but a limited incision should be made in the prostate and neck of the bladder, these structures being merely notched, and the opening being dilated with the finger, so as to avoid opening up the pelvic fascia. The difference between an incision that opens the capsule of the prostate, and dilating this structure by the finger, is very great. The great object in lateral lithotomy is not to open up the pelvic fascia with the knife; and it is difficult, if not impossible, to tear this with the finger. If we take an aponeurosis out of the body, it will be found to be very difficult to tear; but if touched ever so lightly with the knife, it separates at once. So, in the median operation, the prostate may be dilated to a considerable extent without opening its capsule. I have used the word "dilate;" but dilatation appears to me to be an erroneous term. I believe that the prostate is not simply dilated, but partially lacerated: that there is an actual laceration of the substance of the prostate, but not extending into or through its capsule. I have often examined the prostate in the dead subject, after it has been subjected to this process of "dilatation," and have always found its substance more or less torn. A laceration of the substance of the prostate, however, is of no consequence, and only becomes dangerous when it amounts to rupture of the capsule, when it exposes the patient to the fatal accident of extravasation of urine and diffuse inflammation of the pelvic fascia.

Now, in the lateral operation, in running the knife down the groove of the staff, the Surgeon may readily, unless care be taken, and very often, I believe, does actually and almost unavoidably go beyond the limits of the prostate, and thus exposes the patient to all these dangers. In the median this cannot be done, if the knife be not used after the urethra is opened, the prostate being dilated solely with the finger. So far as this point, then, is concerned, the median may be regarded as safer than the lateral operation, it being *impossible* to open up the pelvic fasciæ with the finger in the median, whilst they *may* be opened by the knife in the lateral.

In fact, the neck of the bladder and the prostatic portion of the urethra are in the median operation placed very much in the position of the female urethra when that is dilated for the extraction of a calculus ; being dilated to a great extent, somewhat lacerated perhaps, but not torn through so as to admit urine into the fasciæ of the pelvis ; and in that I believe the great and essential superiority of the median over the lateral operation to consist.

6. **Manipulation of the Forceps and Extraction of the Stone.**—In the adult, the main difficulty of lithotomy does not lie in entering the bladder, but in the completion of the operation, that for which the operation has been undertaken—the removal of the stone. And the difficulty and danger increase in proportion to the size of the calculus ; the tissues between the neck of the bladder and the perineal integuments must either be widely cut or extensively torn and bruised to allow the passage of a large stone. No amount of simple dilatation of which these tissues are susceptible can make a passage through them that will allow the extraction of a stone 1½ or 2 inches in diameter ; such a stone must either be cut or torn out. Now, what space have we in the median operation for the introduction of the forceps and the extraction of a large stone ? Here, I think, is the weak point of the median operation. In it the incision is made, and all the manipulation is practised, towards the apex of the narrow triangle formed by the rami of the pubic bones. The base of this triangle is represented by a horizontal line corresponding to the level of the membranous portion of the urethra, and consequently does not occupy the widest part of the perinæum ; it is formed by the lower portion of the deep fascia, supported and filled up by the rectum and the tissues which are attached to and support the gut on each side. These parts form a rigid wall or barrier stretching across the perinæum, which cannot be depressed, and requires to be divided laterally into the ischio-rectal fossa before a stone of any considerable magnitude can be removed. It was in consequence of the extensive bruising and laceration of these structures, and the difficulty experienced in bringing the stone through them, that the old Marian operation fell into disuse.

In performing the median operation there are three points, or rather planes, of obstruction, between the surface and the interior of the bladder. The first is occasioned by the muscles of the perinæum, and, perhaps, also by the under portion of the deep perineal fascia. In the lateral operation we cut across this plane, and lay open the ischio-rectal fossa, giving abundance of room for the manipulation of the forceps and the extraction of the stone, along the base of the triangle formed by the rami of the ischiatic and pubic bones. But in the median we have to extract towards the summit of this space, at the apex of a narrow triangle, having the muscular structures forming a tense bar along its base, and offering a material obstacle to the introduction of the forceps and the extraction of the stone.

The second obstacle lies in the prostate; but, as it is easily removable by dilatation, it cannot be considered a serious one.

The third, the deepest and most important, is situated at the neck of the bladder. We find here a narrow tense ring beyond the prostate; and this bar remains intact in spite of the dilatation and laceration to which the prostate has been subjected. On introducing the finger, we shall feel it grasped tightly by this ring. I have found, by experiments on the dead subject, this inner ring of the neck of the bladder cannot be expanded to a size more than sufficient to extract a calculus of one inch in diameter without laceration or incision: and its laceration or rupture is well known to be one of the most dangerous and fatal accidents in lithotomy. It is in consequence of the obstacle offered by this, that the median operation is not available for the extraction of large calculi. A calculus two inches in diameter cannot be extracted by the median operation without the employment of great violence. But, though much force is usually required in order to extract a calculus of even moderate size through this tense ring at the neck of the bladder, it is an undeniable fact that serious consequences seldom follow the violence so used, and that a degree of force, which would be fatal in lateral lithotomy, may be employed without danger in the extraction of a calculus by the median operation. In this respect the extraction of a calculus by the median operation resembles the removal of one through the dilated urethra of the female; the great point in favour of the median over the lateral procedure, and the cause of its comparative safety, being that the pelvic fasciæ are not incised, nor otherwise opened. But, it may be said, what is easier, when the finger is in the bladder, than to push a probe-pointed bistoury along it, and cut downwards and outwards through these structures into the ischio-rectal fossa, if the stone be large, and thus get plenty of space? Nothing could be easier or more simple; but what would be the consequence? We at once reduce the median to the conditions of the lateral operation. A free incision in the neck of the bladder and prostate increases the tendency to hæmorrhage, opens up the fascia, and exposes the patient, in fact, to all the dangers of an ill-contrived lateral operation, destroying at once and altogether the principle of the median operation—viz., dilatation, and not incision; and, if we do not gain space by incision, but attempt to extract a moderately large stone by dilatation of the parts, we shall certainly not succeed, but our dilatation will end in a laceration, not only of the substance of the prostate, which is safe, but of the neck and perhaps of the base of the bladder, which will be fatal. Urinary fistula was common after the old Marian operation. It remains to be seen whether it will be so after the modern median.

In conclusion, then, it appears to me that the median operation, when performed in suitable cases, has the advantages over the lateral of being attended by less risk of arterial hæmorrhage, and less danger of injury to the pelvic fasciæ; but, that in consequence of the very small size of the opening that can be made in the bladder by it, *provided these advantages are maintained*, it is only applicable to stones of at most a medium size, and that it cannot in all cases be substituted for lateral lithotomy, as the general operation for stone, where lithotrity is not admissible.

**Indications for the Median Operation.**—The median operation may with propriety be performed in the following classes of cases. 1. In cases where foreign bodies, such as pieces of bougie, of tobacco-pipe, &c., are lodged in the bladder, the median is preferable, the body being small, elongated, and easily extracted. 2. It may be employed to remove stones not exceeding one inch in their smallest diameter. But then, it may be said, calculi of this size can generally be safely subjected to lithotrity. That is true ; but, in certain of these cases, lithotrity is not admissible ; so that the median operation is indicated in cases of small calculi in which lithotrity cannot be practised in consequence of irritability of the bladder, or of the patient being too weak to bear repeated sittings. If a small calculus be lodged just behind the prostate, in a pouch which occasionally forms at a lower fundus of the bladder, we may come down on it at once by the median incision. 3. When there are numerous small calculi, lithotrity is not desirable, and then the median operation appears to be preferable. 4. In cases in which lithotrity has been performed, and the patient is unable to expel the fragments, we may perform the median operation, and readily extract the detritus by the scoop, as it lies behind the prostate. 5. In the case also of calculi which are too large to be successfully subjected to lithotrity, but which, if removed by the lateral operation, are attended by a frightful rate of mortality, it seems to me that the median operation might possibly be advantageously combined with lithotrity. The stone having been broken up at one sitting, the fragments might at once be extracted through a limited incision in the mesial line of the perinæum. 6. In cases in which the patient is so anæmic that the loss of an additional ounce or two of blood might turn the scale against him, median is preferable to lateral lithotomy. For, although it is by no means almost a bloodless operation, as is supposed by some, yet there is less hæmorrhage during the performance, or rather, perhaps, less continuous oozing after its completion, than in the lateral, and there is certainly not the danger of the profuse bleeding that is sometimes seen in that operation. Where we have to do with a stone of large size, the median is not, in my opinion, safe ; such an amount of traction must be used as will infallibly bruise and lacerate the neck and base of the bladder, and expose the patient to infiltration of urine and deep pelvic inflammation—to all the dangers, in fact, of the old Marian operation ; dangers which were so great that more than half the patients subjected to it perished, and which caused it to be abandoned for the lateral.

I have said nothing special about the performance of the median operation in boys. Under the age of puberty, lateral lithotomy is a very successful operation ; certainly the most successful of all the *great* operations in surgery. The median can scarcely prove to be superior to it in this respect ; and unless it can be shown to possess decided advantages over the lateral in ease of execution—and in this particular respect, in my opinion, it falls far short of the lateral—it does not appear to me to be desirable to abandon an operation of proved safety for one that is still on its trial.

BILATERAL LITHOTOMY.—The bilateral operation introduced by Dupuytren is a modification of the old median. In it a curved transverse incision is made across the perinæum half an inch above the anus, towards which its concavity looks, the horns of the incision extending to two-thirds of the distance between the anus and the tuber ischii on each side (Fig. 754). The dissection is care-

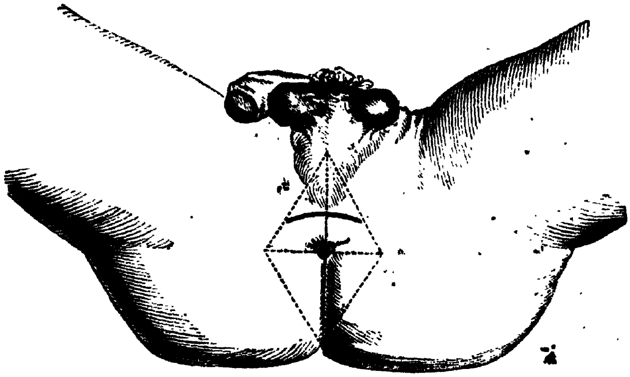


Fig. 754.—Line of Incision in Bilateral Lithotomy (Dupuytren).

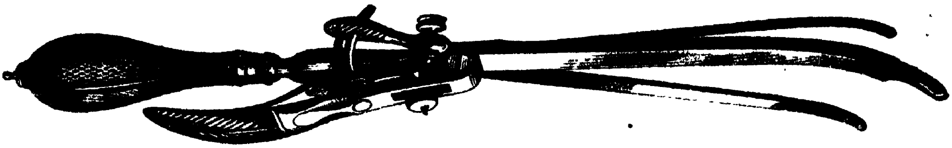


Fig. 755.—Dupuytren's Lithotome Caché, Opened.

fully carried down to the central point of the perinæum, and the membranous portion of the urethra is opened on a grooved median staff previously introduced; along this the double *lithotome caché* (Fig. 755) is passed with its concavity turned upwards. The Surgeon, having well assured himself that the instrument is fairly in the bladder, turns it so that its concavity looks down towards the rectum; the spring in the handle is then pressed, and the blades expanded to a proper distance previously regulated, and both lateral lobes of the prostate divided to a corresponding extent downwards and outwards in withdrawing the instrument (Fig. 756). The extraction of the stone is then effected in the usual way. This operation appears to me not to have received the attention from Surgeons in this country that it deserves. By being careful not to open the intestine, and to introduce the lithotome into the membranous portion of the canal, the arteries of the bulb are not endangered, and indeed the transverse and superficial arteries of the perinæum are also above and beyond the line of incision. The prostate is divided equally on both sides in its greatest diameter; if the expansion of the lithotome be carefully guarded, there is no danger of going beyond the limits of that organ, or of wounding the internal pudic arteries (Fig. 757); and the interior of the bladder is reached by the most direct and the readiest passage. In withdrawing the lithotome, the handle must be well depressed, and great care must be taken that the instrument be kept securely in the mesial line, so that the section may not be made more freely in one side than the other.

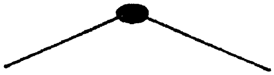


Fig. 756.—Bilateral Section of Prostate.

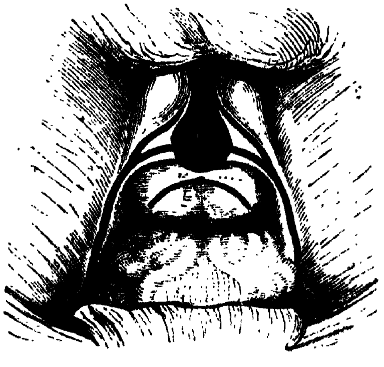


Fig. 757.—Line of Incision in the Prostate in Bilateral Lithotomy, showing its relation to the Bulb and the Internal Pudic Artery.

The operation has not been performed with sufficient frequency in this country for any reliable statistics as to the results. But Eve of Nashville has done it in 78 cases of all ages, with a mortality of only 8.

**Medio-Bilateral Operation.**—Civiale has recommended a combination of the median and the bilateral operations of lithotomy, by which the chief objections to both are got rid of. This operation is best suited for the extraction of large stones from the bladder; for those calculi, in fact, which cannot be removed by the ordinary median operation without too great an amount of force, and consequent bruising or laceration of the parts. It is easy of execution, seems likely to be attended by little risk of hæmorrhage, of urinary extravasation, or of pelvic inflammation, and opens the bladder at the part which is nearest the perineal surface.

The operation may be performed in the following manner. The patient having been tied up, and a deeply grooved rectangular staff passed into the bladder, the urethra is opened at the membranous part with the edge of the knife turned upwards, as described in the median operation (p. 796); the double lithotome is then slid along the staff into the bladder, its concavity turned downwards, the blades expanded to but a limited extent, and the prostate, or the bilateral gorget (Fig. 758), invented by Dr. J. Wood, of New York, may be pushed along the staff, and the soft structures between it and the surface incised as it is withdrawn. If the stone be not very large, the incision may be confined to one side only, and made with a probe-pointed bistoury. It will be found that sufficient space is obtained by the perpendicular incision of the skin; whilst the limited internal transverse cut removes that tension and resistance of the deeper structures, which in the ordinary median operation interfere seriously with the manipulation of the forceps and the extraction of the stone; and, by the division of both sides of the prostate to a limited extent, abundance of space is obtained. More extended experience has shown, however, that the advantages are rather theoretical than practical, and that its performance in this country has been attended by unsatisfactory results two of the principal dangers being wound of the rectum, and tearing through the sphincter.

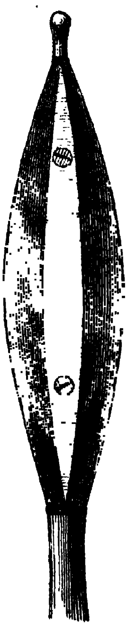


Fig. 758.—Wood's Bilateral Gorget.

Many other modifications of the median and the bilateral operations have been practised by varying the direction of the external incision, and by making the internal one on one or both sides of the prostate, or by notching this structure in various directions.

**High or Suprapubic Operation.**—Although the median and lateral operations for lithotomy are perhaps the safest for the extraction of stones of small or moderate size, yet there can be no doubt that their results are extremely unfavourable when the calculus exceeds a certain magnitude; and in these circumstances it may be deemed expedient to perform the "high operation" in preference to them. It is fortunate, however, that large calculi are comparatively rarely met with, and will doubtless become more rare, as the diagnosis of stone can now be made at a very early period of the existence of the calculus, and as the treatment is now generally preventive. Thus, of the 703 Norwich cases, that form the basis of Crosse's tables, and indeed of our chief information on these points, 529 were under 1 ounce in weight; 119

weighed from 1 to 2 ounces; 35 from 2 to 3; 11 from 3 to 4; 5 from 4 to 5; and only 4 were above this size. Hence, if we confine the high operation to those instances in which the calculus is above such a size as will readily admit of extraction through the perinæum, we shall seldom have occasion to perform it; yet instances occasionally occur in which no other method of extracting the calculus presents itself. Thus, by this method, Uytterhoeven succeeded in extracting a calculus, of which he has kindly given me a cast, which measured 16½ inches in one circumference, and 12½ in the other. It was perfectly moulded to the shape of the inside of the bladder, and clearly could not have been removed by any incisions through the perinæum, as the outlet would have been insufficient for its extraction. The patient survived the operation eight days.

But not only may the high operation be required on account of the size of the calculus; it may be rendered necessary by other conditions, such as the existence of so much rigidity about the hips in consequence of rheumatic disease, as would prevent the proper exposure of the perinæum; or by that region being the seat of disease which would interfere with any operation being practised through it; or the pelvic outlets may be so contracted by rickets as to prevent the possibility of the extraction of a stone through them by any of the perineal operations.

*Operation.*—The high operation consists in making an incision through the abdominal wall, above the pubes, and opening the anterior part of the bladder underneath the reflexion of the peritoneum that passes upwards from its superior fundus.

In performing this operation, it is necessary that means should be taken to raise up the fundus of the bladder, so that it may project above the pubes, and thus admit of being safely opened. With this view various contrivances have been invented, such as catheters containing sliding stylets, which can be pushed through the bladder when that viscus is exposed. These instruments, though ingenious, are not necessary; for the end of an ordinary catheter introduced through the urethra, and made to project above the pubes, will serve as a sufficient guide.

The bladder having been slowly but fully injected with tepid water, so that it may arise above the pubes, an incision, about three inches in length, is to be carried from the pubes directly upwards in the mesial line. The pyramidales are then to be cut across near their origin, the linea alba exposed, cautiously opened near the pubes, and divided upwards some little way. The peritoneum must next be pushed back, and the dissection carefully carried through the areolar tissue above the bone, until the instrument previously introduced can be felt through the bladder, when, if it contain a sliding and pointed stylet, this may be pushed through the coats of the bladder; if not, an incision must be made down upon it, and the aperture in the organ enlarged downwards towards the neck of the bladder by means of a probe-pointed bistoury, so as to admit the fingers. The forceps must then be introduced, and the calculus extracted.

After the operation, there will always be risk of the occurrence of urinary infiltration into the areolar tissue around the margins of the wound. In order to prevent this, the older Surgeons kept the bladder empty by making incisions through the perinæum into the membranous portion of the urethra or neck of the bladder, thus complicating seriously the operation; but this accident may best be prevented by introducing a gum elastic catheter into the urethra, and leaving it there for a few days until consolidation has taken place and the wound shows a disposition to close, pressure being at the same time kept up on the lips of the incision.

Another cause of danger in this operation is wounding the peritoneum, which may occur in consequence of the contracted state of the bladder causing it to lie low in the pelvis, and thus preventing the proper introduction of instruments to carry it up above the pubes.

Dulles finds that the suprapubic is far less favourable than the lateral in its results for calculi below ℥j. in weight. For those between ℥j. and ℥ij., there is little difference, whilst for calculi above ℥ij., it is far more favourable. He states that, of a gross total of 465 cases of the suprapubic operation, in both sexes there had been 135 deaths, or a mortality of 1 in 3·44; the mortality being about 1 in 3 in males, against 1 in 8·2 in females. This high rate of mortality may to a certain extent be accounted for by the fact that the patients subjected to suprapubic lithotomy were on an average one-third older, and the stones four and a half times heavier, than in the cases subjected to the lateral operation. Dulles gives a table of 43 cases operated on by American Surgeons, of which 14 died, or as nearly as possible 1 in 3. This agrees with the statistics previously published by Humphry, who collected 104 cases in which this operation had been performed; of these 31 proved fatal, chiefly from peritonitis and urinary infiltration—the mortality amounted consequently to 1 in 3⅓; and Souberbielle, one of the greatest modern advocates of this operation, lost 1 patient in 3. The general result, therefore, is not very satisfactory; though, as in many instances the operation was performed in cases in which the lateral method was not applicable on account of the size of the stone, we cannot with justice compare the two procedures in regard to the mortality attending them.

# CHAPTER LXIX.

## URINARY CALCULUS (*continued*).

### LITHOTRITY.

THE operation of **Lithotrity**, by which the stone is crushed in the bladder and the pulverised fragments are expelled or extracted through the urethra, is of modern, and indeed of very recent invention; for, notwithstanding that various rude and incomplete attempts may at different times have been made with this view, it was not until about the year 1818 or 1820 that the subject began to attract serious attention: and to the French Surgeons is undoubtedly due the great merit of having not only introduced but perfected this operation. About this time Civiale, followed by Amussat, Leroy, and others, began constructing instruments, which, though very imperfect, yet were sufficient to break down a calculus in the bladder. This was publicly done by Civiale in 1822. From this period the system made rapid progress; and the successive improvements made by the Surgeons whose names have just been mentioned, together with the ingenious mechanical adaptations introduced by Weiss, Heurteloup, Costello, and Charrière, enabled Surgeons to attack the stone with certainty and effect. It is principally due to the labours of Civiale in France, and of Brodie and Weiss in this country, that the system has been brought to its present state of perfection; whilst the practice of lithotrity has been largely adopted and urged upon the Profession by Sir W. Fergusson, Coulson, Sir H. Thompson, and many other Surgeons. To Sir Henry Thompson more especially, the Profession is indebted for having laid down with precision those rules by which the operation may be performed with as much simplicity as safety.

For the safe and proper performance of this operation, the Surgeon must not only be acquainted with the general principles on which it is undertaken, but he must be thoroughly conversant with the more minute details in the construction and the manipulation of the instruments employed, as well as with the state of every part of the urinary organs. It is impossible for any Surgeon who wishes to practise lithotrity successfully, to devote too much time and attention to these points of detail.

INSTRUMENTS.—The instruments required for lithotrity are the following.

An ordinary *sound* with a short beak is required to examine the condition of the bladder. The steel sound should be hollow, so that the bladder may, if necessary, be injected through it after or during sounding, without the necessity of changing the instrument (Fig. 759). This will be found of much service in the later stages of the operation for detecting small fragments.

A *brass syringe*, with rings, and having a large piston rod, so that it may work easily, should be at hand, and admit of adaptation to the hollow sound.

The Surgeon should also be provided with *silver catheters* of three different kinds: one with large lateral eyes, another with a large eye in the convexity, and a third with a large eye in the concavity near the point (Figs. 773, 774, 775); all having an elastic gum bougie fitted to the interior, instead of a stylet, to clear out the fragments (Fig. 776). These should also fit to the syringe.

The instrument for breaking the stone consists of a **lithotrite**, as represented in the annexed cuts (Figs. 760, 765, 766); or a similar instrument worked by a rack and pinion is employed by Fergusson. The lithotrite must be made of well-tempered steel; and should be tested by being made to crush a piece of sandstone grit, of about the size of a walnut. It should be of as full a size as the urethra will readily admit; it must have the male blade well serrated, and the female or under blade open at the beak, with an oval aperture, through which the detritus of the crushed stone is forced, and thus any entanglement of it between the blades is prevented (Fig. 760).

The object of this open-bladed lithotrite is to break the larger and harder stones into pieces; but it is not intended to pulverise smaller calculi and fragments.

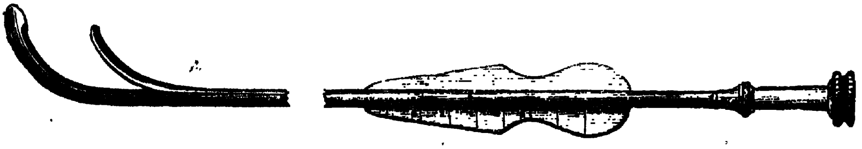


Fig. 759.—Lithometer Sound for measuring Stone. It is hollow, so that the bladder can be emptied and injected through it.

The lithotrite should be cut out of a bar of solid steel, and not, as is the case with some instruments, made of a plate of this metal, turned up at the edges; as such an one possesses too little strength to be used with safety on large and hard calculi. Those cut out of a bar of metal have an external blade, having a grooved shape, as in Fig. 764. In this, the male or internal branch, cut to fit accurately (Fig. 763), slides smoothly, the whole instrument possessing an

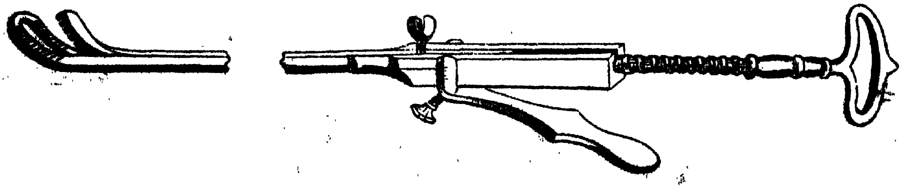


Fig. 760.—Weiss's Thumb-screw Lithotrite for breaking the Stone.

amount of strength and power that no calculus can resist. The bent-up instrument is composed of an outer tube of metal, as represented in its transverse section (Fig. 762), in which the internal blade fits less accurately (Fig. 761), and which possesses less strength, especially at the elbow, than the lithotrite cut out of the solid. The scoop may, however, be constructed of bent metal without danger.

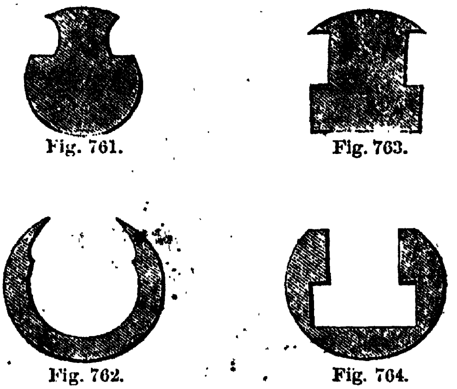


Fig. 761. Fig. 763.
Fig. 762. Fig. 764.
Sections of Lithotrites.

Civiale's lithotrite, such as is represented in Fig. 765, has a most ingenious double action, enabling the Surgeon to work it either by the hand or by a screw. In this instrument, there is no fenestra in the female blade. It is of two kinds. In one, the male blade is much narrower than the female ; in the other, it is nearly as broad. The first kind is useful in crushing through moderate-sized stones ; the second kind, with the broad male blade, is used in completely crushing up and removing the detritus of small calculi, and the large fragments into which a stone has been broken by the open-bladed lithotrite.

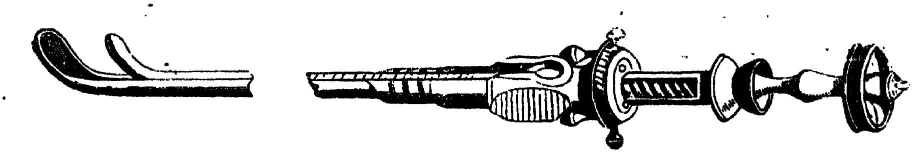


Fig. 765.—Civiale's Lithotrite for Crushing Fragments.

Weiss and Thompson's lithotrite (Fig. 766) somewhat resembles Civiale's in its action, but is more handy. It is made with a fenestrated female blade for breaking the stone, or with a scoop for crushing fragments.

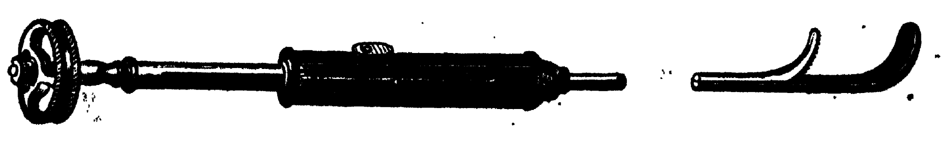


Fig. 766.—Weiss and Thompson's Improved Lithotrite.

Preparation of the Patient.—Before proceeding to the operation of lithotrity, it is necessary that the patient's constitution should be carefully attended to ; the bowels should be freely opened, and the condition of the digestive organs regulated, and, more especially, all local irritability about the urinary organs should be subdued by ordinary medical treatment. This is even of much greater importance in lithotrity than in lithotomy. In lithotrity, we must always expect that any existing irritation or inflammation of the bladder will be increased by the necessary introduction of instruments, and by the presence of sharp fragments of calculus in the bladder, and their passage along the urethra; but in lithotomy all source of irritation is at once removed by the extraction of the stone. The condition of the urinary organs must be very carefully examined: and, if these be diseased, it will probably be requisite to abandon the operation.

In a subsequent part of this Chapter, when we come to the comparison of lithotomy and lithotrity, we shall examine the conditions which either indicate or negative the performance of the latter operation. At present, we will suppose a case in which the Surgeon may have recourse to lithotrity with every prospect of readily and permanently freeing the patient of his calculus; one in which the calculus is of moderate size, single, and not too hard; the urinary organs healthy, and not over sensitive; and the patient an adult, but not too aged. In performing the operation in such a case, but little preparatory treatment is required; though it is well to keep the patient quiet for a few days, and to regulate his bowels before anything is done. Should the patient's health not be in a satisfactory state, or should his urinary organs be irritable, he must be treated on ordinary medical principles until his health be sufficiently restored for the Surgeon safely to undertake an operation. Should the patient be nervous about the use of instruments, or should the urethra be irritable, a large sound may be passed every second day, so as to accustom the patient and the parts to the use and contact of instruments.

USE OF ANÆSTHETICS.—Much difference of opinion exists as to the advisability of employing chloroform in lithotrity. It has been objected to its use that the sensations of the patient are an useful guide to the Surgeon in his manipulations; and that, if these be annihilated by anæsthetics, injury may be done by the lithotrite nipping or otherwise bruising the mucous membrane. But this objection is not tenable. It is the sensations of the Surgeon, and not those of the patient, that constitute a valuable guide; although in the majority of cases lithotrity, when properly performed, is almost a painless procedure. Yet cases not unfrequently occur in which the patient can with difficulty support the necessary manipulations, and in which, either from nervousness or from irritability of the bladder, he ejects his urine on the introduction of the lithotrite, or even does not allow his bladder to be duly distended by injection. In such cases chloroform is of inestimable service; and many patients when anæsthetised can be safely subjected to lithotrity, who could not suffer the operation under other circumstances.

OPERATION.—The operation of lithotrity may be divided into three stages: 1. The Introduction of the Instrument. 2. The Search for and Seizure of the Stone. 3. The Crushing of the Stone.

1. **Introduction of the Lithotrite.**—Lithotrity may most conveniently be performed with the patient lying on his back either upon a hard mattress, or on a couch or table. If the patient be very stout, or the prostate enlarged, the pelvis may be raised by a hard pillow, so as to allow the stone to roll up on the posterior surface of the bladder. The Surgeon, standing on the right side of the patient, carefully introduces the hollow sound, or catheter, and draws off the urine; he then slowly and very cautiously, injects the bladder, by means of the brass syringe, with from four to six ounces of tepid water. The use of drawing off the urine is to make sure of the bladder holding the proper quantity of fluid when it is afterwards injected; and the object in injecting it,

is to distend it with fluid to such an extent as to prevent the mucous membrane from being seized in the grasp of the lithotrite, or injured by the splintering of the stone. The instrument is then withdrawn, after the situation of the stone has been detected by it, and the lithotrite is introduced. Should the patient be able to hold enough urine to protect his bladder from the action of the lithotrite or the fragments, the injection may be dispensed with, and the lithotrite may at once be used. As this is straight, with a sharp elbow near the beak, some little skill is required in passing it. In doing this the Surgeon must keep his eye upon the short curved beak of the instrument, the direction and position of which must be constantly observed or rather judged of; and especial care must be taken, in carrying it under the pubes, not to injure the urethra by pushing the beak of the lithotrite forwards too suddenly, instead of winding it, as it were, under the arch of that bone. The instrument should first be introduced nearly parallel to the abdomen, the penis being held between the left fore and middle fingers, and drawn over it. As the lithotrite passes down, it must be gradually raised to the perpendicular position; and as its curve passes under the pubes, the handle should be depressed between the thighs (Fig. 767). The direction of the curve is the thing to bear in mind; and the position of the handle must be varied in accordance with the course which this takes. The lithotrite should be well greased with olive oil, so that the branch and screw may work smoothly. Lard or ointment should not be used for this purpose, as it is apt to clog, and to entangle gritty bits of calculus.

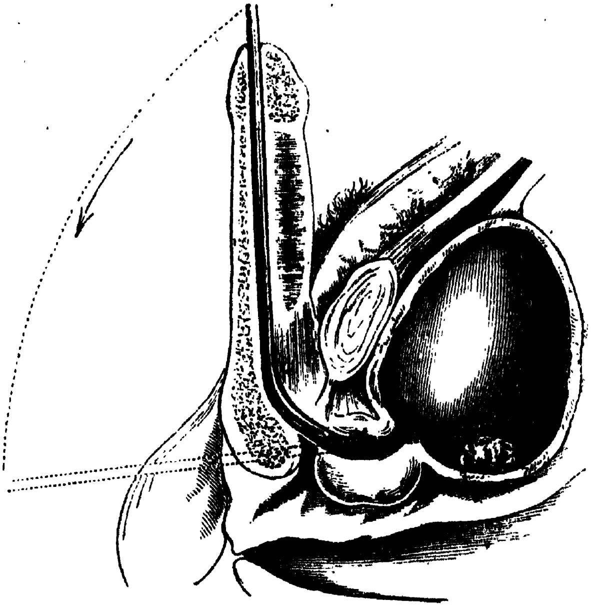


Fig 767.—Introduction of the Lithotrite.

2. **Seizure of the Stone.**—The next point is to seize the stone, which will generally be found in the situation where its presence was detected during the sounding of the bladder. If large, the stone will probably lie low, near the neck of the bladder; if small, it is most frequently met with at the right side, or at the inferior fundus. Should it be situated in a depression in this region, it may most readily be seized by introducing a finger into the rectum, and raising up the lower part of the bladder; or, better still, by raising the pelvis on a hard pillow, and so causing the stone to roll up on the posterior surface. Brodie strongly advises that the lithotrite should never be used as a sound to ascertain the position of the stone; if this be done, the patient suffers pain, the bladder is irritated, the urine is expelled, and the stone not readily

seized. In seizing the calculus, a good deal of tact is required. There are two ways of seizing the stone. Brodie recommends that it should be done by pushing the female blade of the lithotrite against the inferior fundus of the bladder, pressing gently down with it so as to make a conical depression in this situation, and then inclining the beak towards the stone, drawing back the male blade with the thumb (Fig. 768); with a slight shake or jerk, the Surgeon then tries to get the calculus between the blades, at the same time that the male branch is being pushed forwards to seize it. In this manœuvre the female blade should be moved as little as possible, but the stone must be seized by pressing the thumb upon the half-circle of steel fixed on the male branch. In this way the stone may often be seized at the first attempt, but in other cases it is not grasped until after several efforts have been made to fix it; the calculus, especially if round, slipping away from between the blades of the instrument, and being merely scraped by them. Civiale adopted another procedure (Fig. 769). In passing the lithotrite, he felt where the stone lay

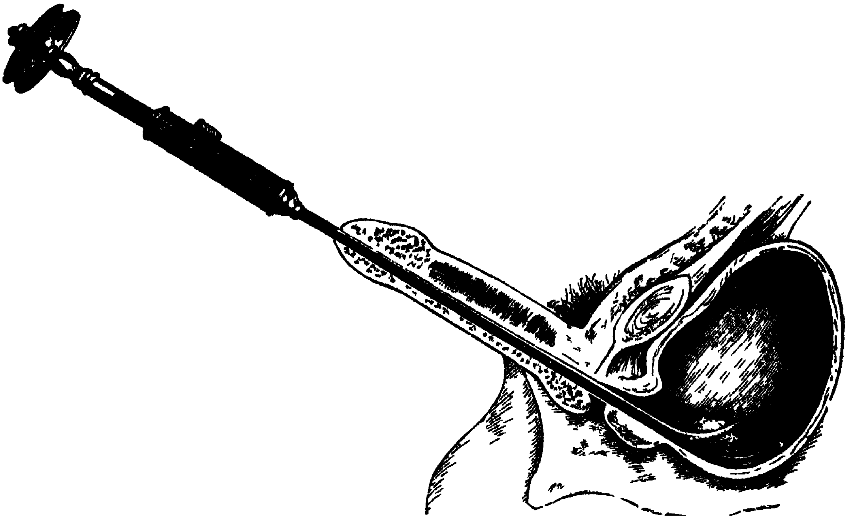


Fig. 768. –Brodie's Method of Seizing the Stone.

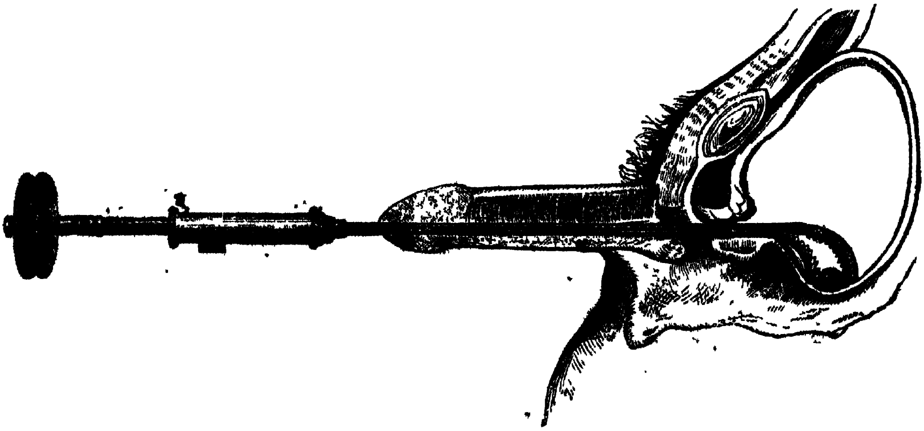


Fig. 769.—Civiale's Method of Seizing the Stone behind the Prostate.

he then very gently turned the beak of the instrument towards the opposite side of the bladder, opened the blades, and then, turning them over towards the stone, seized it between the open blades. In these manœuvres, all rough handling must be most carefully avoided, and the instrument should be turned about as little as possible. It is far safer to desist in the operation, if there be any difficulty in seizing the stone, than to persevere in repeated and fruitless attempts, by which the bladder may be severely injured and inflamed. Rather than do this, the patient should be allowed to get up and move about for a few minutes, when the position of the stone may be so far altered that it will admit of being seized.

3. **Breaking the Stone.**—When the stone has been seized, it is gently raised in the grasp of the lithotrite, so as to be placed about the middle of the bladder, and it is then crushed. The important step of the operation, like all the others, requires to be deliberately and carefully done (Fig. 770). If Civiale's improved lithotrite be used, the stone, if small, may often readily be crushed by the pressure of the hand alone without the action of the screw (Fig. 771). If the ordinary lithotrite be employed, the breaking should not be effected by suddenly and forcibly screwing up the instrument, but the screw should be gradually worked by a series of short and sharp turns, so as to constitute almost percussive movements (Fig. 772). In this way the calculus is generally made to crumble down, rather than to fly asunder; and, as it yields, the screw must be worked tightly home. The blades of the instrument may then be opened again, a fragment of the broken calculus seized and crushed in the same way as before; and thus the disintegration of the stone is in a great measure effected and sometimes completed at one sitting. It is of the greatest moment, however, that too much time be not consumed at one sitting. Nothing is more dangerous than the

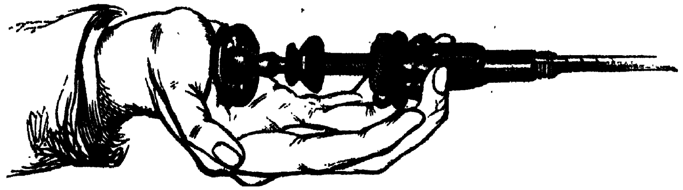


Fig. 771.—Position of Hand in using Civiale's Lithotrite.

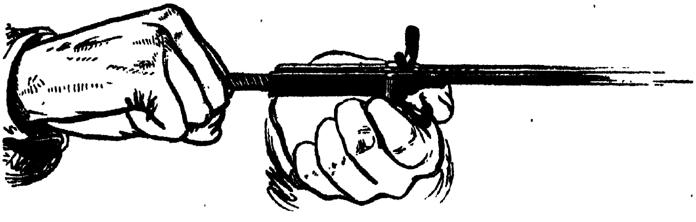


Fig. 772.—Position of Hands in using Thumb-Screw Lithotrite.

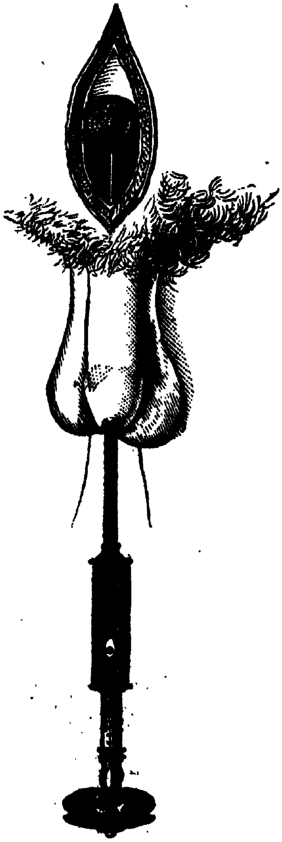


Fig. 770. — Position of Lithotrite, in Crushing the Stone.

long-continued contact of instruments with the interior of the bladder; in this way great irritability, or an atonic condition of this organ, terminating in low cystitis and pyæmia, is apt to be produced, and death may thus result. The shorter the sittings, the more likely will the case be to do well. The first sitting should not exceed four minutes, and the subsequent ones be as short as possible. In the repetition of the sittings, the Surgeon must be guided by the effect produced on the stone and on the bladder. The calculus may be entirely destroyed in one sitting, but most commonly from three to five or six are required; these should, if possible, be conducted at intervals of three or four days, though this must depend upon the amount of irritation induced by them.

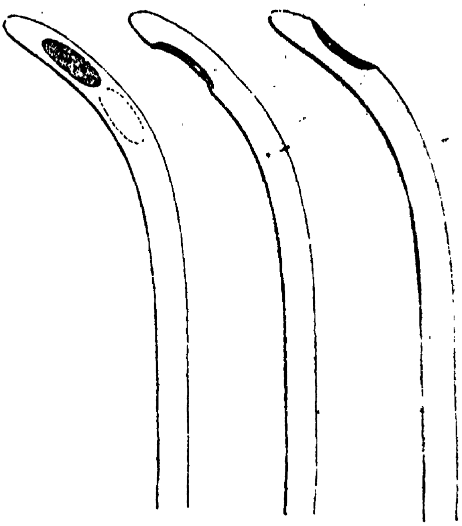
At the first sitting, it is sufficient to break up the stone; the fragments being left to be dealt with subsequently. This sitting is by far the most important of all; it should not occupy more than about a very few minutes. After the stone has been broken up, the patient should be made to lie in bed on his back for about twenty-four hours, be kept warm, and be plentifully supplied with diluents. He should pass water in an urinal, and not be allowed to stand up or to lean forward, lest the fragments fall against or become fixed in the neck of the bladder, where they may produce great irritation and distress. Much of the success of lithotrity will depend upon the gentleness with which the proceedings are conducted during the first sitting, and the care with which the patient is managed for a day or two subsequently.

Before withdrawing the lithotrite, the Surgeon must be careful to see, by the scale on the handle, that the male blade is well home. If this be not the case, and the instrument be enlarged by any fragments or detritus being entangled between the blades, laceration of the neck of the bladder or urethra might occur in attempting to withdraw it.

After the stone has been broken, little detritus will usually escape during the first twenty-four hours; but after this it is expelled, in some cases in considerable quantity, each time the urine is passed. In others, it does not escape so readily; and then the Surgeon requires to introduce Civiale's instrument (Fig. 765), by which he can seize the smaller fragments, crush them, and, screwing the instrument home, extract the beak filled with detritus. In using this instrument, however, care must be taken not to get hold of too large a fragment; for in breaking this up, whether by the hand or screw, the beak may be clogged with the detritus in such a way that it does not readily close, and then there may be considerable difficulty in withdrawing it. Should this accident occur, the scoop may be emptied by passing its beak back into the bladder, tapping sharply upon the instrument, and moving the male branch to and fro. In crushing fragments behind the prostate, Civiale turned the concave part of the beak downwards, and seized the fragment this position (Fig. 769). In doing this, however, great care must be taken not to nip the mucous membrane of the bladder.

There is a difference in the practice of Surgeons with respect to washing out the bladder. Thompson very usually does not do so; other Surgeons wash out the bladder after each sitting, except the first, with tepid water. The most convenient instrument for this purpose is a full-sized silver catheter, nearly straight, and having a large eye in its concavity (Fig. 774). This acts as a scoop, and will bring away large quantities of fragments that will not readily escape through a catheter with lateral eyes, or that has an opening at its convexity. For bringing away the finer detritus, when mixed with mucus, a double current catheter is useful. In using the latter instrument, the point of which should be directed towards the inferior fundus, a considerable quantity of water may sometimes with advantage be pumped through the bladder by adapting a flute-valve syringe or elastic bottle to it.

Clover has invented a most ingenious and simple instrument (Fig. 776), for washing out the bladder. It is especially useful in the latter stages of the operation, and more particularly in clearing the organ of the last fragment.



Lithotrity Catheters.

Fig. 773.—Eyes at Extremity.
Fig. 774.—Eye in Concavity.
Fig 775.—Eye in Convexity.

The interval between the sittings will vary according to the effect produced. If all go well, the second sitting may usually take place about five or six days after the first, and they may then be repeated at intervals of from three to four days; each sitting should be short—not exceeding five to eight minutes. When the Surgeon believes that the bladder has been emptied of all fragments and detritus, a *final exploration* must be made. This last act of the operation is necessarily one of the greatest importance, as on the precision with which it is conducted depends in a great degree the future immunity of the patient from a recurrence of the disease; any fragment, however minute, that is left behind necessarily constituting the nucleus of a further calculus.

The exploration is best conducted by means of a small lithotrite, the bladder containing but a moderate quantity of urine. The whole of the interior, but especially the part behind the prostate, should be carefully explored; and if any fragment be found it must be crushed, and the detritus extracted. Civiale employed the "trilobe," allowing the urine slowly to trickle out through the shaft of the instrument, at the time when he drew and closed the blades over the floor of the bladder, by pushing the tubular shank over them. As a measure of additional safety, the exploration should be repeated after the lapse of a week or two, and the bladder be well washed out after each procedure.

During the whole of the treatment, it is necessary to adopt means to allay irritation. With this view the patient should be kept in bed, or on a couch; a moderate diet only should be allowed, plenty of demulcent drinks given, such as barley-water, soda-water, or milk; and opiates or henbane, if necessary, should be administered.

The amount of irritation of the bladder developed after lithotrity will vary greatly in different cases. In some, where the stone, when unbroken, has excited much pain and irritability of the organ, the sufferings are at once lessened by its being broken up. It is difficult to account for this, except on the supposition that the fragments, being spread over a wider surface than the unbroken calculus, press less directly on any one part, and so produce less local irritation. More frequently, however, the crushed stone produces much greater irritation than the unbroken one. In this respect, however, much will depend upon the care that is taken after the operation. If the patient be kept lying on his back, if diluents be freely given, and opiate and belladonna rectal injections used, the irritation from this source will be materially lessened. But if the patient be allowed to walk about, and to pass urine standing up or leaning forwards, some of the fragments may be driven into the neck of the bladder, or even the deeper part of the urethra, producing there the most intense and painful strangury. When this unfortunate accident occurs, the patient will pass urine every half-hour or oftener, squeezing out a few drops, writhing, and perhaps screaming with the agony he suffers, as the vesical neck contracts on

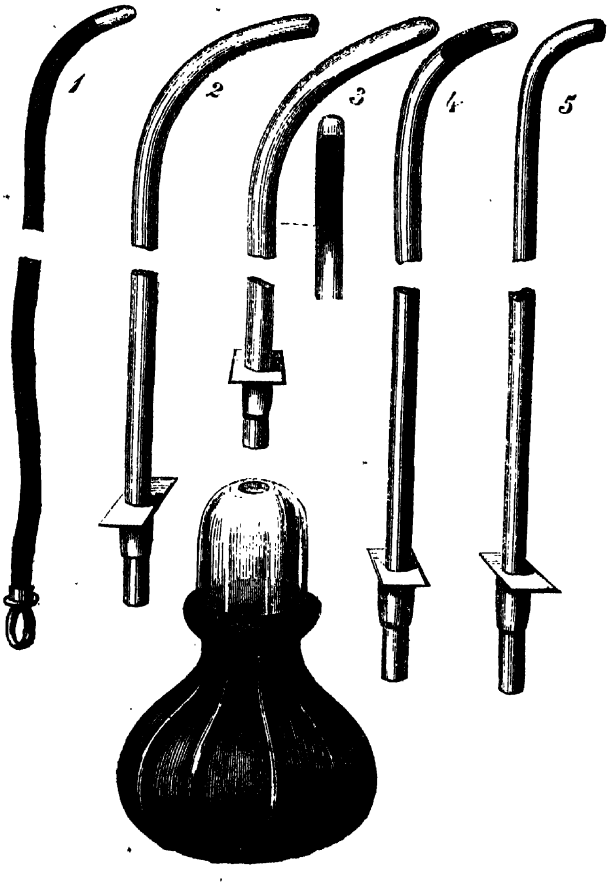


Fig. 776.—Clover's Lithotritic Injection-Apparatus. 1. Elastic Stylet for Lithotrity Catheter. 2, 3, 4, 5. Lithotrity Catheters with large eyes at end or in different sides, to be used with or without the Injection Apparatus.

the rugged fragments; his pulse will become quick, his skin hot and perspiring, his tongue dry, the urine scanty, high-coloured, and perhaps more irritating; and unless relief be speedily given, nervous exhaustion will set in, and death ensue. In such unfavourable circumstances no time is to be lost. The patient should be anæsthetised, the bladder injected with weak belladonna solution, the lithotrity-scoop introduced, the fragments broken up as completely as possible, and detritus taken away or washed out. No other means than this, or lithotomy, will save the patient; and nothing is more remarkable than to witness the immense relief that the patient derives when the large angular fragments are broken up into detritus.

ACCIDENTS IN LITHOTRITY.—In considering the accidents in lithotrity, I put out of consideration those that may arise from the Surgeon acting carelessly, or with improper force, and thus occasioning laceration of the urethra, or injury to the coats of the bladder; so also accidents occurring from the bending or breaking of the instruments will scarcely happen, if these have been properly tested on a piece of sandstone grit before being employed in the bladder.

**Impaction of Angular Fragments of Stone in the Urethra.**—This is a most dangerous and painful accident, and not only occasions great local irritation, ending perhaps in cystitis or abscess, but may give rise to severe rigors and nervous prostration. It most commonly arises either from the Surgeon attempting to do too much at the first sitting, or from the patient moving about too much, or straining to pass urine after the stone has been broken. The fragments are especially apt to lodge in the prostatic urethra, or about the bulb, and there give rise to a very great degree of irritation, and even of fatal mischief, producing great constitutional disturbance of an irritative and asthenic type. When the pieces are impacted low down in the urethra, it is absolutely necessary to remove them from the canal as speedily as possible, lest the constitutional disturbance occasioned by them prove fatal to the patient. This may be done in various ways. Most frequently, they may be pushed back into the bladder, by passing a large catheter carefully down to them. The most convenient instrument for this purpose is one that is open ended, so that the fragment may be received in the aperture at the end of the instrument, and so pushed on before it. Through such a catheter as this a stream of water may be injected, and the fragment thus forced back. Should these manœuvres fail, it has been proposed to crush the fragments in the urethra with a small lithotrite (Fig. 777); but this plan is somewhat hazardous, as it is very difficult to avoid pinching up the mucous membrane of the canal with the bits of stone. The safest practice seems to be, either to extract them through the urethral orifice, or to cut them out through the perinæum. Extraction through the urethral orifice may be effected by the forceps (Figs. 778, 779), or by Civiale's

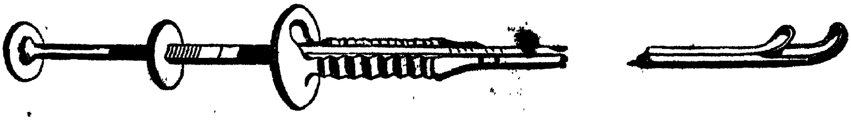


Fig. 777.—Urethral Lithotrite.

instrument (Fig. 257, Vol. I.). Should these means fail, or should the fragment be very deeply seated, as in the membranous portion of the urethra, and the local and constitutional irritation produced by it be so great as to threaten abscess or a fatal termination, the better plan would be to make an incision directly down upon it, and to remove it through the perinæum by a median operation of lithotomy. If such an operation as this be required, the Surgeon might possibly feel disposed to extend the incision a little, and empty the bladder of any remaining detritus by means of a scoop.

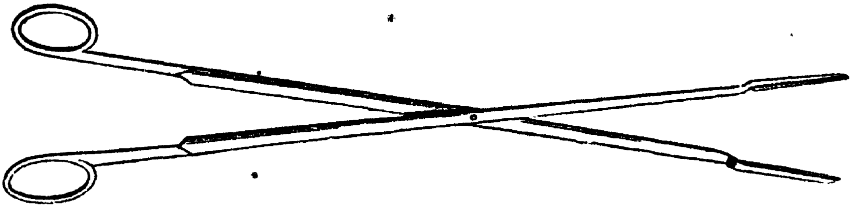


Fig. 778.—Urethral Forceps.

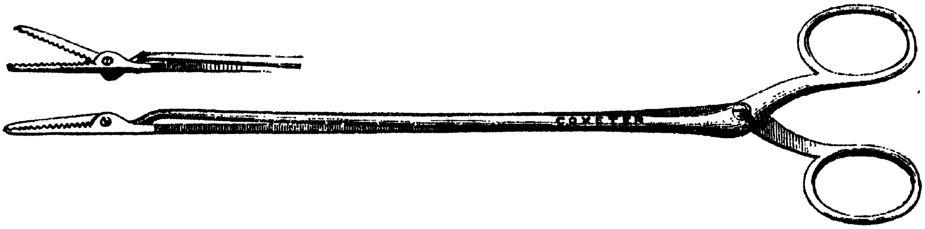


Fig. 779.—Urethral Forceps, with Alligator-jaw action. The smaller figure presents the Jaw of Forceps opened.

The **Chronic Enlargement of the Prostate** of old people complicates seriously the operation of lithotrity, not only in rendering the introduction of instruments more difficult, but in offering an obstacle to the expulsion of the fragments. Enlarged prostate cannot, however, be considered to be by any means an insuperable bar to lithotrity; as, after the stone has been crushed, the bladder may be emptied by means of the scoop, by Clover's apparatus, or by Sir P. Crampton's device, which consists in exhausting the air from a properly constructed bottle, fitted with a stop-cock, and then attaching this to a catheter previously introduced, and opening the stop-cock, when the pressure of the atmosphere drives the contents of the bladder, urine and grit, into the exhausted bottle. As a general rule, it is not desirable to turn the blades of the lithotrite downwards, lest the floor of the bladder be injured. But in some cases in which a small stone is lodged, or fragments have fallen into a pouch behind the prostate, or in which the prostate is enlarged so as to form a bar which rises above the floor of the bladder, it will be impossible to seize the calculus or the fragment, unless this manœuvre be adopted. In doing this, risk of injury will be materially lessened, if not altogether removed, by somewhat depressing the handle of the lithotrite, and thus preventing all downward pressure of the blades, which are gently opened and closed over the base of the bladder.

DANGERS IN LITHOTRITY.—The principal dangers in lithotrity arise from the state of the bladder and kidneys. They consist in the induction of Cystitis of a low form, Atony of the Bladder, of Renal Irritation, or in the occurrence of Pyæmia, with much constitutional disturbance of a low type.

**Cystitis** may occur in consequence of the increased irritation to which the bladder is subjected. It sometimes occurs during the earlier period of the operation, in consequence of the irritation of the bladder by large and angular fragments, and subsides at once when these are crushed up and pulverised. Should it continue, it speedily assumes a low form, and is apt to prove fatal by the induction of acute secondary inflammation of the kidneys or septicæmia; even if it do not do so, its continuance is an insuperable obstacle to the further crushing of the stone; and in cases of this kind the best course that could be pursued will be, after getting the patient into as favourable a state as possible, to remove the fragments by lithotomy.

**Atony of the Bladder** is one of the most dangerous conditions that can occur in lithotrity. This state of things happens usually in old people, in whom the urinary organs may appear to be in a peculiarly quiet and favourable condition before the operation, the patient being able to hold his urine for six or eight hours, and to bear the injection of ten or twelve ounces of fluid. In these circumstances, the Surgeon should be upon his guard; for the danger of this condition is, that the bladder does not possess sufficient contractile power to expel the fragments. These consequently accumulate in the lower fundus, and irritate the mucous membrane, and thus the foundation may be laid for fatal cystitis, which in these cases always assumes a typhoid type.

The atony of the bladder appears to arise partly from that natural want of expulsive power, which is not unfrequent in old people, and partly from a kind of paralysis of the organ, induced by the contact of the instruments, especially after long sittings, and by the pressure of the fragments, by which the bladder is, as it were, overpowered. Such patients usually die with severe constitutional depression, and with suppurative inflammation of the kidney.

When atony of the bladder has come on, it is essential that the Surgeon should rid the patient of the fragments which he is unable to expel. This may sometimes be done by means of the scoop, assisted by washing out the bladder through the large-eyed catheter; but the safer plan would probably be, to get the patient into as good a condition as possible, and then cut him. This I once did in an interesting case under my care at the Hospital; the patient, an old man, had been lithotrised by a Surgeon out of doors a few weeks before admission, but no fragments had passed; on sounding him, I found a moderate-sized calculus, with what appeared to be a large mass of soft concretion, of the nature of which I was not aware until after its removal; the patient having concealed the fact of his having been lithotrised. On cutting him in the usual way, I removed a lithic acid calculus about as large as a pigeon's egg, and a handful of fragments of another calculus of the same composition, which had been crusted over and matted together by phosphatic deposit. The patient made a very good recovery. In such cases I should, in future, perform the median operation, and clear out the bladder with a scoop.

**Disease of the Kidneys** is in Lithotrity as in all other operations on the urinary organs, the most common cause of danger and of death. The various forms of fatal kidney-disease have been so fully described in Chapter LXVII. that I must refer the reader to it.

**Constitutional Disturbance.**—Very considerable constitutional disturbance occasionally follows lithotrity. The patient is seized with severe and long-continued rigors, followed by profuse sweating, lasting for many hours. These serious symptoms are most apt to come on after the first sitting, and are analogous to those nervous phenomena that are apt to follow upon the introduction of instruments in strictures, &c. They may pass off, leaving merely a temporary debility; or a typhoid state may set in; the pulse becoming quick, feeble, and intermitting, the skin hot and dry, and the tongue brown. This condition is apt to prove fatal, either directly, or by intercurrent visceral mischief; it appears to arise in many cases from causes independent of the operation, or that are called into activity by the shock and slight constitutional disturbance induced by it. This is more especially apt to happen when there is latent disease of the kidneys. Indeed, there is no condition of system that is more directly antagonistic to the success of lithotrity than chronic disease of the kidneys. When this occurs to any considerable extent, with or without much albumen in the urine, casts of tubes and blood, the increased irritation induced by the operation will almost to a certainty prove fatal. In other instances, again, the fatal result is more directly dependent on the irritation induced by the operation leading to the formation of abscess in the neighbourhood of the prostate, or around the neck of the bladder; and in other instances, again, on the supervention of unhealthy suppuration in some of the sacculi that are occasionally met with in this organ. From whatever cause arising, this condition is usually eventually fatal by the supervention of suppuration of the kidneys or septicæmia, and is undoubtedly often predisposed to by the previous existence of chronic renal disease.

The *Treatment* of this state of things should consist in the free administration of stimulants—brandy, ammonia, and ether—followed by a full dose of opiate, and abundant warm diluents. Especial care must be taken not to repeat the sitting for at least a week or ten days after the rigors have passed off.

PERINEAL LITHOTRITY.—After a stone has been broken up in the ordinary operation of lithotrity, it occasionally happens that the fragments become a source of so much irritation that the crushing operation has to be abandoned, and lithotomy is required, in order to relieve the patient. Again, during the operation of lithotomy, the operator may meet with so large a stone, that he cannot extract it with safety, and he then breaks it up in order to remove it in a fragmentary manner, or the stone may be so soft that it crumbles under the pressure of the forceps. These circumstances, familiar to all lithotomists, have led various Surgeons to recommend, as a formal operation, the breaking up of calculi before extraction, in order that the removal of the broken stone might be effected through a smaller incision than would be required for its extraction if entire. Without going back to the records of ancient or even mediæval surgery for illustrations of this operation, it suffices to say that in modern times such a procedure has been advocated by many distinguished Surgeons, more especially by Malgaigne, under the term of "Lithotriptic Lithotomy."

Dolbeau has reduced to a formal operation, which he has described as "*Perineal Lithotrity,*" those procedures which were formerly undertaken without any very definite rules.

The operation itself is extremely simple. It consists of four stages: 1. The making of an incision in the median line into the membranous portion of the urethra on a grooved staff; 2. the slow and gradual dilatation of the neck of the bladder by means of a six-bladed "dilator;" 3. the introduction through the dilated neck of the bladder of the "lithoclast," a powerful forceps for seizing and breaking up the stone; and the extraction of the fragments and pulverised stone by means of small forceps and the scoop.

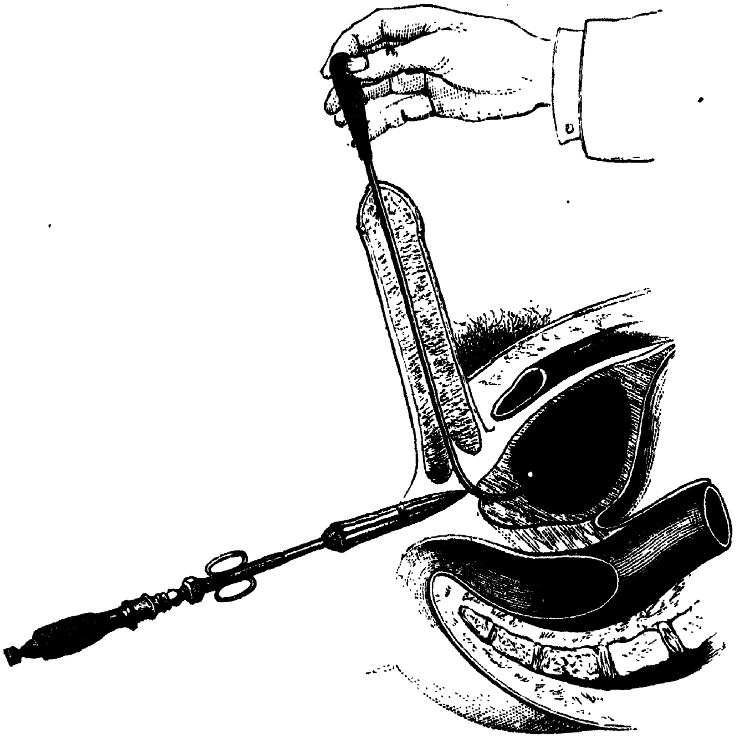


Fig. 780.—Perineal Lithotrity. Introduction of Dilator (Dolbeau).

M. Dolbeau gives very minute directions for the proper performance of the various stages of the operation. They resolve themselves into the simple rules of a moderate external incision, very slow and methodical dilatation of the prostatic urethra and vesical neck, and complete "fragmentation" of the calculus.

From our knowledge of what happens when a stone is accidentally broken by the crush of the forceps during an ordinary lithotomy operation, we should not entertain very sanguine views of the results of the same procedure when purposely performed. The delay in extracting the broken fragments is great—the bladder emptied of its urine contracts upon and is irritated by them, and the uncertainty and difficulty of clearing away all fragments by means of forceps, scoop, and injections, are very considerable. The accident is one that is justly dreaded and guarded against as far as possible by the practical lithotomist.

*Results.*—The results of perineal lithotrity do not either appear hitherto to have been very brilliant or even satisfactory. In thirty operations there were five deaths, which, considering that at least four of the patients were under twenty years of age, is fully as high as, if not higher, than what occurs in lateral lithotomy, and far exceeds that resulting from lithotrity.

*Applicability.*—When we compare perineal lithotrity with ordinary lithotrity, or lithotomy, whether lateral or median, it presents positive disadvantages in many cases, no advantage in others, and appears only to be applicable to a few exceptional instances.

In cases of small or medium-sized calculi, the results of ordinary lithotrity are infinitely more satisfactory; and no object can be gained by complicating this operation with an incision into the urethra.

For ordinary calculi, too large for lithotrity, the lateral and median operations offer fully as successful if not more successful results than those which have been obtained by perineal lithotrity; and very few Surgeons would, when once they had seized the stone, trouble themselves to break it up before extracting it, or subject their patient to the delay in the operation that always occurs, even when the stone is accidentally broken after seizure—a delay occasioned by the prolonged manipulations which then become necessary, and which are not without their own special dangers.

The only cases, indeed, in which I can conceive perineal lithotrity to be adopted by a Surgeon, are those in which he has to do with a very large soft phosphatic calculus. As such a stone almost inevitably crumbles down when seized before extraction, it might possibly be as well to convert into a step of a regular operation that occurrence which would otherwise happen as an accident in ordinary lithotomy.

Should it become necessary, after ordinary lithotrity, to cut a patient for the speedy extraction of the fragments, Dolbeau's method of dilating the neck of the bladder, and his small forceps, might be found useful.

## COMPARISON BETWEEN LITHOTOMY AND LITHOTRITY.

Lithotomy and lithotrity differ so entirely from one another in principle and detail, that it is useless to attempt to establish a comparison between the different steps of these two operations. It is, however, a question of the very first importance and interest to ascertain by which operation a patient can most safely have a calculus removed from his bladder. In determining this point, it is not only necessary to make a comparison between the general results of cases that have been subjected to the two procedures, but more especially to ascertain those circumstances that influence the result of each operation in particular cases—to determine, in fact, in what cases lithotomy, and in what lithotrity, holds out the best prospect to the patient. It is, I think, in the highest degree unpractical to enter into a discussion as to which should be the general method of treatment in cases of stone. That Surgeon shows his practical skill the best, who knows best which operation is the one most appropriate to the particular case before him, and who knows best how to apply the operation that he selects to the case to which it is applicable. Both operations have been reduced to great simplicity and certainty; but neither should be exclusively practised. It is undoubtedly the duty of the Surgeon to make himself familiar with the practice of both, and to adopt that one which promises best in the particular instance with which he has to do. In all cases in which it is practicable, and in all cases even in which the chances of the two operations are evenly balanced, lithotrity should as a matter of humanity be preferred to lithotomy. Probably about four-fifths of all cases of stone occurring in the adult are proper for lithotrity, and the proportion would be much greater if the patients applied earlier for relief, or if, instead of being subjected to medical treatment, they were at once put under proper Surgical care, and the stone detected.

STATISTICS.—The statistics cannot represent the true state of the question so far as a general comparison between the operations is concerned. For it must be borne in mind that those cases that are lithotrised have invariably been picked; whilst lithotomy has been performed on almost all patients indiscriminately as they have presented themselves. For lithotrity to be successfully done, it is necessary that the stone be of moderate size, and that the urinary organs be in a healthy state and free from irritation: and this is the state in which most of the cases have been, in which crushing has been done. In lithotomy cases, on the other hand, the Surgeon has had to contend with all the difficulties of large or multiple calculi, diseased bladders, and bad constitutions. Hence, in comparing the statistics of the results of lithotrity with those of lithotomy, we compare the statistics of the results of operations performed under the most favourable circumstances on a series of selected cases, with those of cases taken indiscriminately and often presenting most unfavourable conditions.

Another cause of uncertainty with regard to the statistics of lithotrity has been this; that up to a recent period those which we possessed were chiefly from a professed lithotritist, Civiale, the accuracy of which had been denied in a very decided and emphatic manner by many of the leading Surgeons in Paris, who had inquired fully into the matter; and the conclusions from which must necessarily be received with much hesitation in this country, where it is difficult to arrive at the real truth of the statements advanced on either side.

If we compare Civiale's statistics of lithotrity with those of lithotomy, as practised by the most skilful Surgeons, Cheselden, Liston, and the Norwich operators, we should at once decide in favour of the crushing method; for Civiale states that out of 591 operations he had but 14 deaths, or 1 in 42·2; whilst, as we have seen, the most skilful lithotomists in this country, where the results of the cutting operation have been far more successful than elsewhere, can only boast of such a rate of mortality as 1 in 7·9, or at most in 10. But though the success is thus stated by Civiale to have been great in his own cases, the accuracy of this statement has been denied by other French Surgeons, and it is certainly very different from what has occurred elsewhere. Thus of

162 cases operated upon by lithotrity by various Surgeons in Paris, Civiale states that death resulted in 38, and a cure in 100 instances; the results of the remaining cases being unknown, or the cures incomplete. In this country it is impossible to say, even approximately, what the average mortality after lithotrity has been; but I believe there is a very general feeling that, in many of the London hospitals in which it has been performed, lithotrity has not been a very successful operation. The same remark appears to hold good with regard to the Parisian hospitals; Malgaigne estimates the mortality from lithotrity in these institutions at 1 in 4, while he calculates that of private cases as 1 in 8. This difference between the results of this operation in hospital and in private practice can easily be accounted for by the difference in the constitutions of the patients, and by their applying for relief in private in a less advanced form of the disease than in hospital practice. We find that the same holds good with regard to the results of lithotomy. Thus, Coulson states that Dudley lost only 1 in 36 of the *private* patients that he cut; Mettauer, 1 in 36½; Martineau, 1 in 42; and Mott, 1 in 50. These results are fully as favourable as Civiale's statistics of lithotrity, and show the influence which the constitution of the patient, and a proper selection of cases, may exercise upon the results of the cutting operation. The only statistics of lithotrity that we at present possess are those given by Brodie, Fergusson, Keith, and Thompson as the result of their practice. Brodie's cases were almost entirely private ones; and many occurred early, before the art was perfected, hence they are scarcely fairly applicable to the present day. He states that, out of 115 cases of lithotrity—not all, however, on different individuals, the operation having been repeated more than once on several of the patients—he lost 9. Of these, death was directly attributable to the operation in 5 instances; and in the remaining 4, it was dependent on organic disease, brought into activity by the shock of the operation. Fergusson lost 12 out of 109 cases, and Keith 7 out of 129. Thompson's statistics show by far the most favourable results that have yet been obtained. He operated in 184 consecutive cases, of which only 3 were under 30 years old, the mean age being 61, the oldest 83, and in 46 cases 70 and upwards. The recoveries, excluding every kind of casualty, amounted to 93 per cent. No case was left unfinished; in no case was lithotomy required; and in 13 cases only was a second operation demanded.

Lithotrity, as has already been stated, cannot be applied to all cases of stone; in most that are unsuited to this operation, lithotomy may be done with success. In some cases, however, no operation can be practised, in consequence of serious disease of the genitals, bladder, or kidneys, or of some visceral mischief that would necessarily interfere with the performance of any capital operation. The necessity of *selecting* cases of lithotrity is well instanced by a statement that Civiale has given with reference to this point. This dexterous lithotritist considered that, of 838 calculous patients who applied to him during a series of twenty years, only 548 were fit cases for lithotrity, and 290, or more than one-third, were not operated on by this method; of the last 322 cases included in this list, 241 were lithotrised, 1 in 3·6 being considered unfit for that operation. Of the 91 cases not crushed, 28 were cut, and in 8 others lithotrity and lithotomy were combined. Of these 36 cases subjected to lithotomy, Civiale lost 18, or exactly one-half. These figures show that lithotrity cannot be considered the only operation for stone; but must, even in the hands of the most dexterous and successful practitioners, be in many instances replaced by the cutting operation.

SELECTION OF OPERATION: LITHOTOMY OR LITHOTRITY.—The circumstances that must chiefly determine the Surgeon in the selection of the particular operation to be performed are—1, The Age of the Patient; 2, the Size and Character of the Stone; and 3, the Condition of the Urinary Organs.

1. **Age.**—The age of a patient is an important element. As a general rule, it may be stated that at the middle and advanced periods of life lithotrity is most successful; while, in early ages lithotomy is the preferable operation. In children under the age of puberty, the genito-urinary organs are undeveloped; the urethra is small, and the bladder narrow. These conditions not only necessitate the employment of instruments specially constructed of reduced size, and render great care in their manipulation requisite, but the narrowness of the urethra is especially apt to render the expulsion of the fragments of the crushed stone extremely difficult, and to favour their impaction. If, in addition to this, we bear in mind the great sensitiveness of the bladder in young children, and their restlessness under the repeated sittings which may be necessary, it can easily be understood that lithotrity is neither an easy nor a safe operation in them; unless the calculus be so small—not larger than a cherry-stone—that it can be crushed and brought away at one sitting. Lithotomy, on the other hand, is so successful an operation in children, that the Surgeon would gain nothing by substituting lithotrity for it. Thus, of 35 children under 10, operated on by Cheselden, only 1 died; and of 58 children cut for stone at St. Thomas's, but 1 case proved fatal; and the average mortality of lithotomy cases in children is not more than about 1 in 14. Guersant, at the Children's Hospital in Paris, has performed lithotrity in children 40 times—35 of the cases being in boys: of these, 7 died, and 3 at least of the others required to be afterwards subjected to lithotomy. Of the deaths, 4 were caused by croup and scarlatina, and 3 were attributable to the operation. These results are anything but satisfactory when compared with those of lithotomy in children in this country, or even in Guersant's own practice; for, of 100 that he cut, 14 died. I think that the best and most experienced Surgeons are agreed in this, that, although lithotrity is practicable on boys, yet lithotomy, being much safer and far speedier, should be preferred to lithotrity in all patients under puberty, and in most under twenty years of age.

At very advanced periods of life, the irritable state of the urinary organs, the tendency to the supervention of low cystitis, and the enlarged state of the prostate, are often such as to prevent the performance of lithotrity with any prospect of success. At the same time, the success of lithotrity in old age has been very great in the hands of some Surgeons. Thus, Segalas states that, of 14 octogenarians whom he lithotrised, he did not lose one; and of 27 septuagenarians, but two. Lithotomy, on the other hand, is very fatal in aged persons.

It is at the middle period of life, or in persons who, though advanced in years, preserve their powers unimpaired, that lithotrity is most generally applicable and is most successful.

2. **Size and Character of the Stone.**—With regard to the *size* of the stone, Surgeons generally recognise the fact that a small stone is more favourable to lithotrity than a large one. All calculi below one inch in diameter may be crushed, provided other circumstances are favourable. In regard to larger calculi, it is, as a general rule, not well to attempt to crush a stone that is above one inch and a half in diameter; much, however, will depend on the composition and density of the calculus. The objections to lithotrity in any given case are, not that a large stone cannot be broken, because in most cases this can be done; but that the fragments may be so large, angular, and sharp, as to require separate crushing to enable them to pass; that their quantity would be so great that the bladder would in all probability not be able to expel them; or that their presence, and the necessary operations for their disintegration and removal, would produce a dangerous amount of irritation. This is especially applicable to *lithic acid* concretions, giving a clear and ringing sound, the fragments of which do not disintegrate, but split up into sharp and angular spicula and scales. *Oxalate of lime* calculi, occurring chiefly in young people, comparatively rarely admit lithotrity, but, when crushed, break up very readily; and, as there is usually a co-existing healthy state of the urinary organs, the cases have a favourable issue. *Phosphatic calculi*, which are soft and friable, and do not yield angular fragments requiring repeated disintegration, may, even if of larger size than that mentioned, be broken up. Some of the French lithotrisers are in the habit of breaking up friable phosphatic calculi of from fifteen to twenty lines in diameter. At the same time, the shattered state of system, and the irritable condition of the urinary organs accompanying phosphatic calculi, often counterbalance the advantage that would otherwise have been derived from the character of the stone.

If there be *several stones*, the propriety of performing lithotrity will depend in a great degree upon the size of the calculi. If these be small—not larger, perhaps, than small nuts, and not very numerous, the bladder being healthy—the operation may be performed with safety. I have removed successfully in a few sittings five or six calculi about half an inch in diameter. But if the calculi be larger than that, lithotrity is not a very successful procedure; for, though each calculus may not be very large, yet the aggregate of the whole is considerable; and, besides this, the calculi will each require a separate operation, as it were, and may each contain a hard and possibly very resisting nucleus. Occasionally the bladder contains a large number of small pea-shaped calculi. These may be successfully broken up, and washed out through a large-eyed catheter; from 50 to 100 separate ones may be thus removed. Sometimes, a calculus, after having been broken up into several fragments, has been left in the bladder, each fragment forming the nucleus for a new stone. Such cases are usually most successfully cut; but in favourable circumstances as to the condition of the urinary organs, they may be subjected to lithotrity.

3. **The Conditions of the Urinary Organs** that influence the propriety of performing lithotrity or lithotomy have reference to the state of the *kidneys*, the *bladder*, the *urethra*, and the *prostate*.

As a general rule, it may be stated that, the greater the irritability and inflammatory tendency of the urinary organs, the less successful will lithotrity be. The repeated introduction of instruments, however carefully and skilfully conducted; the presence of fragments of calculus, and their tendency to impaction or entanglement in the urethra, necessarily dispose to inflammation, even in the most favourable cases, and very readily excite it, if there be any tendency to such action existing in the parts. If, however, the stone be small, or of moderate size, and friable; the bladder healthy, and of good contractile power; the urethra capacious; and the patient of sound constitution and quiet temperament, the stone may often be broken up and the fragments expelled with comparatively little suffering. In fact, in such a combination of favourable circumstances, lithotrity ought unquestionably to be preferred.

If, however, the bladder be very irritable, or if the patient's constitution be an excitable one, so that he does not well bear the introduction of instruments; more particularly if it be found that this local and constitutional sensitiveness, instead of being blunted by the methodical introduction of sounds or bougies, is rather increased thereby; and especially if the stone be of such size that several sittings would be required—lithotomy should be employed.

The existence of organic disease, however, about the urinary organs, constitutes the greatest obstacle to lithotrity; and, when extensive, must form a complete bar to the performance of that operation. It is not easy, however, to determine the amount of local disease that should thus be held to contra-indicate lithotrity. On this point the opinions of Surgeons differ much; and it is particularly in the management of these cases that the advantage of the tact and dexterity in the use of the crushing instruments, which habit can alone give, is well exemplified.

The condition of the *kidneys* merits special attention. If these organs be diseased, as indicated by the presence of casts of tubes, or of a considerable quantity of albumen in the urine, or in any other way, the performance of a series of operations in the bladder would be likely materially to increase the mischief in them, and consequently ought not to be undertaken. Organic disease of the kidneys is a more serious obstacle to lithotrity than to lithotomy, on account of the prolonged nature of the operation, and the greater liability to sympathetic or propagated irritation in these organs, giving rise to purulent nephritis. It is not only by the operation increasing the renal mischief that harm might result, but also in consequence of the tendency to low and diffuse inflammation of the bladder, prostate, and surrounding areolar planes, and to pyæmia, that always co-exists with kidney disease.

The conditions of the *bladder* that interfere seriously with lithotrity are partly functional, partly organic. The functional derangements are of two very opposite kinds; viz., a state of extreme irritability of the organ, and an abnormal want of sensibility of it—a state of atony. The organic lesions consist of hypertrophied, fasciculated, sacculated, and permanently contracted states of the viscus, which is then most commonly irritable as well.

A *chronically inflamed or irritable* state of the bladder, more particularly if the organ be thickened and fasciculated, so that it will not bear the injection of a few ounces of tepid water, seriously interferes with the success of lithotrity. A very irritable and sensitive bladder not only will be the seat of severe suffering on the introduction of instruments, but may not be able to hold sufficient urine to make the operation a safe one, and may readily become dangerously inflamed in consequence of the repeated introduction of instruments, and the presence of angular fragments. Hence, if the ordinary operation of sounding occasion much distress; if the patient cannot hold his urine long, but pass it in small quantities; if it be bloody, or much loaded with viscid mucus, he will scarcely be able to bear the procedures necessary for the operation. In some instances, however, the irritability of the bladder may be overcome, and in all it may be materially lessened, by keeping the patient in bed, and, as Brodie recommends, daily injecting tepid water. If the bladder be *sacculated*, there will still be a greater risk of an unfavourable result; the sacculi not only retaining fragments of calculus, but also becoming the seats of unhealthy inflammation, in consequence of which asthenic cystitis of a very serious character, followed by pyæmic symptoms and metastatic abscesses, may result, leading in some cases to perforation of the peritoneum. In such cases as these, early lithotomy offers the only chance to the patient. The existence of a moderate amount of vesical catarrh, if the bladder be otherwise healthy, is no objection to lithotrity.

In *encysted calculus*, lithotrity is, for obvious reasons, inadmissible.

*Atony of the bladder* is not only a serious inconvenience, but a great source of danger in lithotrity. It cannot in all cases be positively ascertained beforehand; though it may be suspected if the patient can hold his urine for a great many hours, and can bear without complaint the injection of a large quantity—eight or ten ounces—of fluid, the interior of the bladder feeling large and smooth to the sound. This condition chiefly occurs in old men of feeble habit of body; and, if ascertained, calls for the performance of lithotomy. As Civiale has pointed out, this condition may be a source of great danger after lithotrity, the organ not possessing sufficient expulsive power to rid itself of the fragments with which it is encumbered, and of the presence of which it seems to be insensible, so far as the feelings of the patient are concerned; while its low vitality renders it peculiarly liable to subacute cystitis, excited by the presence of the fragments in the lower fundus. It must be borne in mind, that this atony of the bladder may, especially in feeble and aged individuals, be induced by the contact of the instrument, and especially by prolonged sittings.

If the *urethra* be the seat of stricture, or be very irritable, lithotrity—which may require the frequent introduction of instruments of large size, and will entail the continued passage of fragments of calculus—cannot be performed. Stricture of the urethra does not, however, absolutely prevent the performance of lithotrity, but only retards the operation until the constriction can be properly dilated. Should this, however, be not practicable to the full extent of the urethra, lithotomy on a small staff must be practised.

Moderate enlargement of the *prostate*, such as is often met with in elderly people, does not necessarily prevent the performance of lithotrity; though it undoubtedly complicates the operation. The introduction of the lithotrite will be attended by considerable difficulty; and the fragments have a tendency to become lodged in a pouch of the lower fundus behind the enlarged gland.

This more especially happens if the middle lobe be enlarged; and in these circumstances, though the stone may undoubtedly be crushed, yet the fragments would probably require to be removed by the scoop; the operation would consequently be very tedious and prolonged, and lithotomy would probably be found to answer best. Any inflammatory disease or abscess of the prostate must necessarily prevent the performance of lithotomy.

I have said nothing in this comparison between lithotrity and lithotomy of the comparative painfulness of the two operations; for, as chloroform may be administered with equal advantage in both cases, there is little difference in this respect, except that perhaps the advantage lies on the side of lithotomy, as being the shorter proceeding.

From all that precedes, then, it would appear that, useful as lithotrity unquestionably is in many, even in most, cases, it cannot be looked upon as an universal means of treating stone in the bladder, being only safely applicable in favourable conditions of the urinary organs, to calculi that are small, or at most of but moderate size, and after puberty; and that a large number of cases will always be left in which lithotomy offers the sole means of relief.

**Choice of Operation of Lithotomy.**—The particular operation of lithotomy to which recourse should be had, will also vary according to the character of the stone. If this be small, and the patient an adult, the *median* operation may advantageously be performed. If it be of moderate or tolerably large size, and more particularly if the operation be practised on a child, the *lateral* appears to me to be the more applicable. If, again, the calculus be of inordinate magnitude, the *suprapubic*, the *medio-bilateral*, or the *recto-vesical* operation should be the method selected. In fact, the Surgeon should not confine himself too exclusively to any one method of operating, but should adopt that procedure which appears to be best adapted to the special circumstances presented by the particular case before him, and should vary his method according to the state of the urinary organs, the age of the patient, and the size and character of the stone.

**The Result of Operations for Stone** will depend in a great measure upon the condition of the bladder, and the character of the stone. If the bladder be healthy, all symptoms will cease on the removal of the calculus, and the patient will be restored to perfect health. This usually happens when the calculus is of the lithic acid or the oxalate of lime variety, and of renal origin. If, however, the bladder be unsound, irritable, and the urine alkaline from decomposition, and disposed to the deposit of phosphatic matters, the calculus being phosphatic, and chiefly, if not wholly, vesical in its origin, then an irritable state of bladder may be left, or may speedily return after the operation, which will consequently have been productive of little, or only of temporary benefit.

RECURRENCE OF CALCULUS AFTER OPERATION.—This may take place from four distinct causes:—1, in consequence of a continuance of the constitutional condition or diathesis, under the influence of which the calculus was originally formed; 2, from the descent of a renal calculus; 3, from a fragment of calculus having been accidentally left in the bladder; and 4, from the accumulation of phosphatic deposit in the inflamed fundus of the bladder, or in the line of imperfectly healed incisions.

Relapse from the first cause is probably not very common. When it occurs, the recurrent calculus is of course of the same composition as the primary one. The occasional occurrence of relapse shows the necessity of continuing constitutional treatment adapted to the particular diathesis, after the removal of the calculus from the bladder.

Recurrence of calculus from the descent of a new stone from the kidney every now and then occurs, and is especially liable to be met with in those cases in which the primary calculi are multiple and small. In these cases, the relapse may take place very shortly after the first operation, and will be preceded by the usual symptoms of the descent of the renal stone.

Relapse from the retention of a fragment which serves as the nucleus of another stone, will undoubtedly occasionally occur, although its occurrence is fairly attributable to want of due care on the part of the Surgeon. It is apt to happen more frequently after lithotrity than after lithotomy, and it is probably to this cause chiefly that we must refer the greater liability to relapse after the crushing than the cutting operation. But it may happen after lithotomy, that a fragment is left behind when the stone has been broken during extraction, and the bladder not thoroughly washed out. But even in this case, the bit of stone will usually be carried out of the wound by the flow of urine through it.

Recurrence from the formation of a phosphatic calculus in the bladder, or perhaps outside it in the track of a partially healed wound, will occasionally occur after either operation, as the result of a low form of cystitis favouring decomposition of the urine and phosphatic deposits. I have known such deposits to form both in the bladder, and in the perinæum, where the wound had degenerated into a sinus.

The registers of the Norwich Hospital show 1 relapse in 58 cases; and those of Luneville, 1 in 116 cases of lithotomy (Coulson).

After lithotrity, relapse is more common; although it is probably less frequent now than formerly, and will become less frequent as the details of the operation come to be better understood, and are more carefully practised. In the practice of Civiale it has occurred about once in every tenth case. But this estimate, high as it is, falls below what happens in surgical practice generally. Civiale states that, of 36 private patients on whom he operated in 1860, 10 had previously been operated on, the stone having reappeared. This must evidently arise from some fragment of calculus having escaped detection and being left behind, thus constituting a nucleus for a fresh formation. The frequency of the occurrence of secondary calculi after lithotrity, even in such practised hands as Civiale's, if it do not constitute an objection to that operation, shows the necessity of the Surgeon most carefully examining the bladder before he pronounces the patient cured; and even then watching him for some length of time, in order to meet the recurrent calculus at its first formation, and to adopt means for its early removal. Lithotrity cannot therefore be said to be so complete a cure in all cases as lithotomy. Not only is recurrence of calculus more common after the former than after the latter operation, but it not uncommonly happens that patients who have been lithotrised successfully, and in whom no recurrent calculus has formed, continue to suffer for a great length of time afterwards from very distressing irritability of the bladder, which resists in the most obstinate manner all the ordinary methods of treatment. This is not the case after lithotomy; when a patient once recovers, his bladder usually regains its tone completely, and no trace of evil consequences is left.

*Treatment.*—In the event of a secondary calculus forming, whether after lithotomy or lithotrity, either method may again be employed, according to the nature of the case. Most generally, the bladder may be cleared of the recurrent calculus by means of the lithotrite. If lithotomy have previously been performed, and it be thought proper again to have recourse to it, this may be done again in the usual way, through the cicatrix left by the former wound; or the Surgeon, if ambidextrous, may adopt Liston's advice to cut through the right side of the perinæum on a staff with a groove to the left of its convexity. As this procedure, however, would entail the use of the left hand for cutting and extracting, most Surgeons would prefer either the operation through the site of the old wound, or, better still, the median operation. Whatever procedure, however, may be adopted, it should be borne in mind that the rectum may have become rather firmly adherent to the membranous portion of the urethra and the apex of the prostate, in consequence of the contraction of the old cicatrix, and may thus be endangered.

## URETHRAL CALCULUS.

Calculi are not unfrequently found impacted in the urethra, especially in children. These are most commonly formed in the kidney, whence they pass into the bladder, and thence into the urinary canal, through which they usually escape, but in some instances lodge in it, more especially at the bulb or in the navicular fossa. These calculi are commonly of the lithic acid or oxalate of lime varieties; they are generally round, but not uncommonly elongated or spindle-shaped.

But, although most urethral calculi are undoubtedly renal in their origin, there can be little doubt that in some more rare cases they may be primarily formed in the canal. They will then be found to be phosphatic, are usually consequent upon stricture, and may attain a large size. In some cases these concretions are moulded in the prostatic and bulbous portions of the urethra, being elongated, rounded at one end, and pointed at the other. In other instances, again, they appear to be formed in a pouch that lies to the outside of the urethra, and that is only connected with it by a small aperture. I have removed a stone of this kind composed of triple phosphates, weighing an ounce, and about the size of a walnut, smooth and rounded, from a point lying between the upper wall of the urethra and the symphysis pubis, in a clergyman who had for many years suffered from very tight stricture. One of the most remarkable instances of this kind is represented in the annexed cut (Fig. 781), taken from a drawing in Sir R. Carswell's collection at University College. The stone here was of very large size—equal in bulk to two horse-chestnuts.

SYMPTOMS.—In the adult, the presence of a calculus in the urethra may be suspected by the difficulty that is occasioned in micturition, and ascertained by the possibility of feeling the stone through the walls of the canal, or of detecting it by introducing a sound into the urethra. In boys, impaction of calculus in the urethra is almost the sole cause of retention of urine.

When called, therefore, to a child suffering from this condition, we should always at once suspect urethral calculus as being the cause, and examine the urethra by the perinæum or rectum, or by the introduction of a sound.

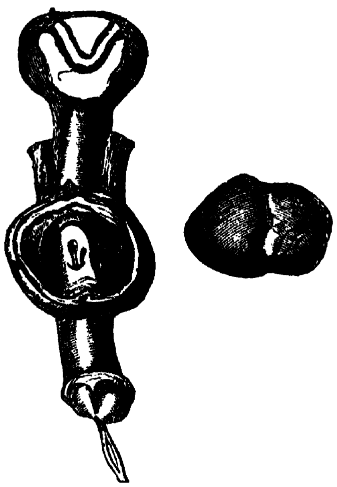


Fig. 781.—Extra-urethral Calculus.

TREATMENT.—The treatment of urethral calculus will vary in the adult and in the child. In the adult, urethral calculi may be removed by extraction, incision, or lithotrity. When situated towards the anterior part of the canal, an urethral calculus may frequently be extracted by quietly working the stone forwards between the finger and thumb, the patient being under chloroform. Should this plan not succeed, it may be removed by passing a long and very narrow-bladed pair of forceps down to it, by which it is seized and drawn forwards; occasionally, when it has reached the navicular fossa, it will not pass through the urethral orifice unless this be dilated by incision with a probe-pointed bistoury. If the calculus be too large to be extracted in this way, and appear to be firmly fixed, an incision may be made down upon it, through the urethra, by which it may be removed. It is a good rule not to make this incision in any part of the urethra anterior to the scrotum; for, in consequence of the coverings of the penile portion of the urethra being very thin, the aperture will probably not be closed, but a fistulous opening left. When the stone is situated in the scrotal portion of the urethra, there would be some risk of abscess and of urinary infiltration if the incision were made through the lax tissues of the scrotum. Hence it is better, if possible, to push the stone back towards the membranous portion of the canal, to cut down upon it, and extract it through the perinæum by an incision in the mesial line. Should it not be thought advisable to cut the patient, the stone may be pushed back into the bladder, and then crushed by a lithotrite. This operation may readily be done by passing a staff, grooved along its convexity, or an ordinary director, as far as the calculus, and making an incision upon the end of it, so as to lay open the urethra; the staff is then removed, and the calculus extracted by means of a slender pair of forceps. A catheter should next be passed into the bladder, and retained there for a few days, in order to lessen the tendency to the formation of urinary fistula.

It may happen that the calculus, impacted in the urethra, is only one of several; others being lodged in the bladder. In order to ascertain this, the Surgeon should, after removing the calculus for which the operation has been performed, pass a sound into the bladder, so as to ascertain whether any other concretions exist in that organ; and if so, they should at once be removed by extending the incision of the membranous portion of the urethra into the bladder, by the median operation of lithotomy. I once saw Liston extract two vesical calculi, after having removed one that had blocked up the urethra, by converting the perineal incision into that of lateral lithotomy.

**Impaction of a Calculus** in the deeper portion of the urethra of a boy may lead to very serious consequences. In the majority of instances it occasions more or less complete retention of urine, which requires relief. This may be given in one of two ways. 1. If the stone be near the urethral orifice, it may be extracted, and, 2, if situated more deeply, it may be pushed back to the perinæum—there fixed by the finger, and cut down upon in the mesial line. It should never be pushed back into the bladder, as such an act would lead to the necessity of lithotomy.

If the stone is allowed to continue fixed in the urethra very serious consequences may ensue, by the ulceration of the urethra by the pressure of the stone, which escapes into the areolar tissue, the formation of urinary abscess in the perinæum, followed, perhaps, by the extravasation of urine into the scrotum, and its diffusion along the superficial fascia in the usual direction, with the ordinary disastrous results of inflammation and sloughing that accompany and follow such infiltration.

In this condition, the boy, after suffering from the ordinary symptoms of vesical calculus, will become affected by intense irritability of bladder, the urine passing with much pain every few minutes; or incontinence even will set in. Some purulent discharge will be observed about the meatus, and there will be some hard ill-defined swelling in the perinæum, with much tenderness in this region. On passing a sound, no stone probably will be found, as this has escaped from the urethra, and is lying in a pouch in some part of the perinæum, and in the midst of broken-down areolar tissue and pus; into this cavity the sound will readily pass.

The *Treatment* in these cases is simple. It consists of introducing a grooved staff, placing the boy in the lithotomy position, and then freely incising the mesial line of the perinæum, so as to open up the urinary abscess; in this the stone may be found, or it may be so enveloped in the sloughy tissues as to escape detection; perhaps it will escape through the wound in a few days, and be found lying on the bed. Should there be much hæmorrhage, a petticoated lithotomy-tube should be introduced. If extravasation of urine have occurred, free incisions must be made in the usual way, and the child be put upon a stimulating diet.

## PROSTATIC CALCULUS.

Prostatic calculus differs from all other urinary concretions in situation and composition, being formed in the ducts of the prostate gland, and composed principally of phosphate of lime and some animal matter; usually about 85 per cent. of the phosphate, to 15 of the organic ingredients. Sometimes, also, the concretion is said to consist of carbonate of lime (p. 756). It generally occurs in old people, though it may sometimes be met with in young subjects. From a lad of nineteen, whom I cut for vesical calculus, I extracted two prostatic concretions.

**Characters.**—Prostatic calculus is usually of a grey or ashy colour, somewhat triangular in outline, smooth and polished (Fig. 782); having facets, being very hard, and seldom much larger than a cherry or plumstone; though it may occasionally attain a considerable bulk, having been met with as large as a hen's egg, and then presenting a branched or irregular appearance. Though usually but one or two exist, which are sometimes deposited in a kind of cyst in the organ, as many as thirty or forty have been met with, the ducts being filled, and its whole tissue being studded with them.

Fig. 782.--Prostatic Calculus.

**Symptoms.**—Calculus in the prostate gives rise to a sense of weight, pain, and irritation in the perinæum, sometimes to retention of urine, and, in fact, to the ordinary symptoms of enlarged and irritated prostate; it often occasions a tolerably free discharge of mucus in the urine. On introducing a sound, this passes over the stone, sometimes rubbing or striking it with a distinct grate or click before its beak enters the bladder. This is increased by the finger in the rectum pushing the organ up, and thus bringing the stone into more direct contact with the sound. In some instances the calculus is deeply imbedded in the prostate, and cannot be touched by the sound. In these cases the stone may usually be felt through the rectum. If there be many small calculi in a sacculus in the prostate, they may be felt by introducing the finger into the rectum, when a peculiar crackling or grating sensation may be experienced by the rubbing together of the calculi, something like that produced by beads in a bag.

**Treatment.**—The treatment of prostatic calculus will depend upon the situation, size, and number of the concretions. When they are large, single, or at most two or three in number, readily struck with the sound, and situated on the urethral surface of the organ, the ordinary median operation may advantageously be performed, and the calculus removed with a scoop or forceps. If the calculi be small and very numerous, not to be felt with the sound, but only through the rectum, it will be wiser not to have recourse to operation, which could not remove the whole of the concretions. In such circumstances, a palliative treatment directed to the subdual of the irritation of the prostate, and the use of the catheter to relieve retention, is the only course to pursue. When prostatic and vesical calculi occur together, the same operation will rid the patient of both forms of the disease. (For foreign bodies in bladder, *vide* Vol. I., p. 651.)

### CALCULUS IN THE FEMALE.

Stone is of rare occurrence in women; in London, certainly, it is not often met with. Thus, South states that, during a period of twenty-three years, 144 males were operated on for stone at St. Thomas's Hospital, and only 2 females. In some districts, however, stone would appear to be more common in women than this. Thus, according to Crosse, at the Norwich Hospital, the proportion has been about 1 woman to 19 men. Civiale states, as the result of his researches, that in the North of Italy, the proportion is 1 to 18; and in France, about 1 to 22. At the University College Hospital we had not had a case of stone in the female for many years until 1855, when three came under my care in the course of a few months: and since that period many have occurred.

Vesical calculi in the female are often nothing more than phosphatic incrustations deposited around some foreign body that has, either accidentally or from depraved motives, been passed up the urethra and has been dropped into the bladder. In this way hair-pins, pieces of bougie, of catheter, or of pencil, will often be found to form the starting point and the nucleus of the concretion.

SYMPTOMS.—The symptoms of stone in the female closely resemble those that occur in the male, and its presence may usually be easily detected by means of a short and nearly straight sound, or a female catheter. It is often simulated very closely by the irritation occasioned by a vascular urethral tumour, or by an irritable bladder; but exploration of the viscus will always determine the diagnosis.

Large calculi may be met with in very young female children. I have removed an uric acid calculus incrusted with phosphates, measuring 1¼ inch in length by ¾ inch in breadth, from a little girl four years old. The stone was removed unbroken, by gradual dilatation of the urethra.

In the adult they may attain a very large size. I have extracted one from a young woman measuring 8 inches in its long, and 6 inches in its short circumference.

Calculus in the female bladder, if allowed to remain unrelieved, will not only occasion the various morbid conditions in the urinary organs that have been described as following the long-continued presence of stone in the male, but will give rise to diseased states peculiar to the female. Thus the stone may be spontaneously discharged through the urethra; if of small size, without any bad results following; but if large, by a process of ulceration, in consequence of which permanent incontinence of urine will remain: or it may slough through into the vagina: or lastly, it may offer a serious obstacle during parturition to the descent of the fœtal head, when, if it cannot be pushed aside to be dealt with afterwards, it must be cut out, or craniotomy be performed.

REMOVAL.—A stone may be extracted from the female bladder by one of three methods: 1, by Lithectasy, through a dilated urethra; 2, by Lithotomy; 3, by Lithotrity. These different operations cannot be employed indiscriminately, but each one is more especially adapted to certain kinds of calculus.

1. **Lithectasy** may be performed in two ways—either by simply *Dilating the Urethra* by means of a sponge-tent or dilator, or else by *Incising the Mucous Membrane* at the same time that the canal is being expanded.

*a.* **Simple Dilatation** of the urethra may be effected quickly by the introduction of a three-bladed dilator, which is rapidly screwed up. In this way, in a few minutes the canal may be easily dilated sufficiently to allow the introduction of a pair of forceps, and the extraction of a calculus of moderate size. Some Surgeons prefer a slow process of dilatation, continued through many hours, by means of a sponge-tent; but this appears to me to possess no advantage over the more rapid expansion, and has the very decided disadvantage of prolonging the patient's sufferings. In the absence of a proper urethral dilator, it is always easy to dilate the canal by means of the finger. With this view a director is first passed, and along this the Surgeon gradually insinuates the tip of his finger, and then soon succeeds in expanding the urethra sufficiently for all ordinary purposes.

*b.* **Dilatation** may be employed conjointly with **incision**, in order to prevent injurious stretching of the urethra, and consequent laceration of its mucous membrane. The incision should be made after the urethra has been dilated to some extent, a probe-pointed bistoury being introduced by the side of the canal, and the mucous membrane divided. Brodie made an incision directly upwards; Liston downwards and outwards on each side—on the whole, I think, the best direction for the incisions, as more space may thus be obtained.

By dilatation, either alone or with incision of the mucous membrane, small stones may readily be extracted; and those calculi that are formed by the phosphatic incrustation of foreign bodies, may be removed in this way. I have thus extracted, by dilatation, a full-sized gum-elastic bougie from the bladder of a young woman. In the removal of moderate-sized calculi, however, the great objection to this operation is the liability to incontinence of urine resulting from it. It is difficult to say to what extent the urethra may be dilated without incontinence resulting; this must necessarily vary in different individuals. It certainly can be expanded sufficiently to allow the introduction of the index-finger, and the extraction of a stone eight or ten lines in diameter, without any evil resulting. The incontinence of urine that may be left after the removal of larger calculi than this may not be by any means complete; but a weakened state of the sphincter of the bladder results, so that the patient cannot hold her urine for more than an hour or two at the most.

2. **Lithotomy** in the female may be performed in a variety of ways. There are, however, only three modes of practising this operation that appear to me to deserve serious attention; viz., the *Suprapubic*, the *Urethral*, and the *Vaginal*.

The **Suprapubic** or **high** operation in women differs in no very material respect from the same procedure in men; except that it requires additional care in consequence of the difficulty there is in causing the female bladder to retain enough urine or water to make the viscus rise sufficiently above the pubes. The extraction of the stone is easy, as it can be raised into the grasp of the forceps by being pushed up from the vagina.

**Urethral Lithotomy** is a very simple and efficient operation. It consists in placing the patient in the lithotomy position, and tying her up. A grooved staff is then introduced into the bladder, and a sharp-pointed bistoury, guided by it, is pushed through the floor of the urethra, about an inch and a half from the meatus, the canal being divided directly downwards. The forceps may then be readily carried into the bladder, and a calculus of good size removed. After the bladder has been cleared, a full-sized catheter should be introduced, and left in the bladder, and the cut edges of the urethra brought together over it by two or three points of silver suture.

**Vaginal Lithotomy** is an operation easy of performance. It may be practised by passing a straight grooved staff into the bladder, pressing the end well down against the anterior wall of the vagina, and fixing it there with the left index finger. A scalpel is then pushed through the anterior wall of the vagina and inferior fundus of the bladder into the groove in the staff, which is made to enter just behind the urethra, and is then run backwards for about 1½ inch; through the aperture thus made the forceps is passed, and the stone extracted. The incision into the bladder through the anterior vaginal wall should be brought together by metallic sutures, as in ordinary operations for vesico-vaginal fistula, and may thus be successfully closed, as has been done by J. Lane, Aveling, and others.

On **Comparison** of these three operations, *urethral lithotomy* is certainly the easiest, the least severe at the time of its performance, and the least likely to be attended by after evil consequences. It is quite sufficient for the extraction of all ordinary calculi. The only possible evil that may result from it is the want of union of the incision. But should this happen, a plastic procedure at a subsequent period can easily remedy the defect that would thus be left.

Both the high and the vaginal operations are easy of performance. In the *high* operation, there would, with care, be but little risk of injuring the peritoneum ; and the chance of urinary infiltration, which is a serious objection in the male, may be prevented in the female by the introduction of a siphon catheter into the urethra. The *vaginal* operation, though easier of performance, is open to the objection of possibly leaving a permanent urinary fistula. If, however, the lips of the incision have not been bruised by the forceps, or in the extraction of the stone, and be immediately brought together by metallic sutures, the risk of a fistula is, after all, not great. Vaginal lithotomy may, in some cases, be the only alternative. I extracted, by this operation, a calculus measuring eight inches by six in circumference, from the bladder of a woman twenty-three years of age, who had suffered from symptoms of stone from childhood. The stone by its size offered so serious an obstacle to the descent of the fœtal head during parturition, that craniotomy had been rendered necessary ; the anterior vaginal wall had been a good deal bruised, and I feared that sloughing of it might take place ; hence I extracted the stone by the vaginal method.

Lithotomy is not so dangerous an operation in the female as in the male ; yet death occasionally occurs, especially in feeble children, from cystitis and peritonitis, more particularly if the extraction of the stone have been tedious and deficient, the bladder being much manipulated.

3. **Lithotrity** in the female requires to be practised on the same principles as in the male. The details of the operation differ, however, in some important particulars. The chief obstacle in the performance of the operation in the female, consists in the difficulty with which the bladder retains urine or water that is injected into it. In consequence of this there is not only great difficulty in seizing the stone, the bladder collapsing and falling into folds around it, but also danger of injuring the mucous membrane with the lithotrite. In order to cause the bladder to retain the necessary quantity of urine, the pelvis must be well tilted up, and the urethra compressed against the lithotrite. It is well not to dilate the urethra before the introduction of the instrument, as the incontinence is thereby increased.

The ordinary male lithotrite is not a very convenient instrument to use in the female bladder, the handle being awkwardly long. This is especially the case in female children. Hence I have found it convenient to have a shorter instrument constructed, with which it is far more easy to manipulate in the female bladder. If urine or water cannot be retained, the calculus may more safely be seized and crushed by means of a small and strong-bladed pair of lithotomy-forceps: or, if the stone be large, by a crushing instrument, made of the shape of that depicted in Fig. 783. In performing lithotrity in the female it is not necessary to pulverise the calculus, but merely to break it up into fragments of such a size as to admit of easy extraction through the urethra.

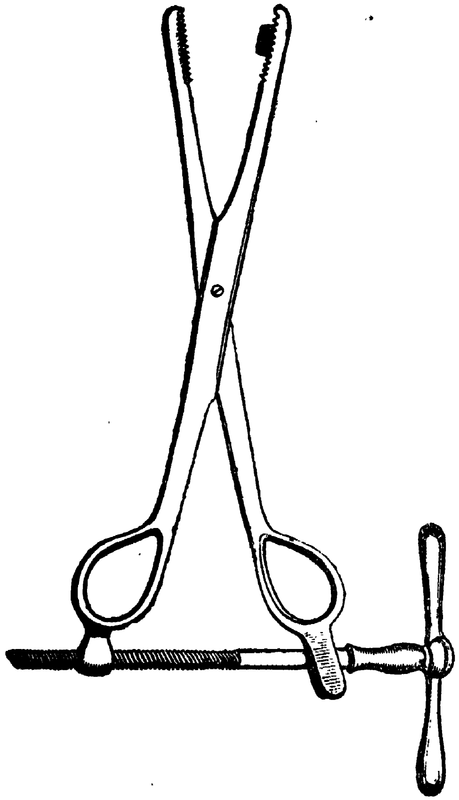


Fig. 783.—Crusher for large Calculus in Female Bladder.

After the stone has been broken up, the urethra (unless this have previously been done) may be dilated by means of the two-bladed instrument to a moderate degree, the larger fragments removed by means of a pair of slender forceps, and the detritus and smaller fragments cleared out of the bladder by repeated injections of tepid water. The whole of the fragments and detritus should be removed at one sitting. The shortness and wide capacity of the female urethra will readily allow the escape of any detritus that may unavoidably be left.

For all calculi in the female bladder, except those of the very largest size, this operation is the most applicable. I have in this way crushed and extracted at one sitting, from the bladder of a lady about 50 years of age, a calculus (phosphatic) fully as large as a hen's egg. By this operation the stone may be removed piecemeal and at once, without the necessity of dilating the urethra to such a degree as to incur the risk of incontinence of urine resulting. Lithotrity may be had recourse to at all ages, in the very young as well as the old. I have crushed and successfully removed a large calculus from a child three and a half years of age, the youngest patient on whom I have operated by this method. Although the urethra of so young a female child cannot without danger of incontinence be dilated to too great an extent, yet it may safely and easily be enlarged sufficiently to admit a moderate-sized lithotrite.

# CHAPTER LXX.

## DISEASES OF THE BLADDER.

### CONGENITAL MALFORMATION.

Extroversion of the Bladder, consisting in an absence of the anterior wall of the organ, with deficiency in the corresponding part of the abdominal parietes, is occasionally met with as a congenital malformation. It may occur in either sex, but is most common in males.

This condition essentially consists in an arrest of development, in consequence of which the anterior part of the pelvic girdle is deficient, the bodies of the pubic bones being imperfectly developed and the symphysis being absent. The recti muscles separate at their lower part, and pass obliquely outwards to be inserted into the lateral abutments of the pubic bones. A triangular space is thus left, into which the bladder is forced, and where its anterior wall, being fused with the common integuments, becomes deficient and thus leaves the interior exposed. At this spot also the umbilical cord traverses the abdominal wall, and thus the umbilicus will be found wanting in all these cases, and the urethra to be in a state of *epispadias*. The posterior wall of the bladder, being pushed forwards by the pressure of the abdominal viscera behind, forms a rounded tumour about the size of a small orange just above the pubes. The surface of this tumour is red, vascular, and papillated, evidently composed of mucous membrane; at its lower aspect the orifices of the ureters will be observed to open, and to discharge the urine in drops or in a stream. For a full description of the mechanism of the passage of the urine in this malformation, I would refer to a case which fell under my notice, and in which I made a number of experiments on the rapidity of the passage of foreign matters through the kidneys, reported in the *Medical Gazette* for 1845.

This malformation is of the most distressing kind. The odour constantly exhaled from the patient by the dribbling of the urine is a source of annoyance to himself and of disgust to others. In order to render his presence at all tolerable to others, this dribbling must be prevented by some mechanical contrivance. With this view the patient should wear a properly constructed instrument to receive and collect the urine, consisting of a hollow shield strapped over the part, communicating by means of a tube with an India-rubber bottle, which may be attached along the inside of the thigh.

*Treatment.*—Up to a comparatively recent period this condition was considered incurable. Of late years, however, operations have been devised and practised with the view of covering in the exposed bladder, forming an anterior wall to the viscus, and restoring the urinary canal; so as to protect the tender extroverted surface of the bladder, to prevent the pain and irritation arising from contact of the clothes with it, and, by giving a proper conduit to the urine, to save the patient all the annoyance of constant dribbling.

The first operation for the remedy of this malformation that was successfully performed was done, in 1859, by Ayres of New York, in the case of a young woman 28 years of age. He, consequently, has the merit of having been the pioneer in this branch of Surgery. He was followed by Pancoast of Philadelphia, and subsequently by Holmes and Wood of London.

**Ayres' Operation.**—The operation practised by Ayres comprised two steps. The first consisted in dissecting down a long flap of integument and of superficial fascia from the anterior wall of the abdomen above the bladder, and turning this down so that the cuticular surface was innermost and lay over the exposed bladder as far as its inferior border. Lateral union was then secured in this position, but the lower part of the flap was left open, so as to allow a free exit for the urine. In this way the bladder was covered in completely by a skin flap, having its cuticular surface underneath, and consequently next to the exposed vesical mucous membrane. The integuments of the abdomen were now sufficiently separated from their areolar connections with the muscles beneath, on each side of the reversed flap, to admit of their sliding forwards, and being united by sutures along the mesial line, so as completely to cover in the exposed raw surface of the flap. In this way the bladder was overlaid by integumental structures, which readily united along the mesial line; and were the patient a male, little more would require to be done than to dissect up the integumental structures below this flap, and so to close in the epispadias and form an anterior wall to the urethra. In Ayres's case, as the patient was a female, the second step of the operation, which was practised after a lapse of three weeks, consisted in fashioning a covering for the vulva, by dissecting up the integuments covering the pelvic bones on each side, and uniting them to one another on the mesial line and to the lower part of the reversed flap.

The principle of the operations adopted by Pancoast, Holmes, and Wood, is essentially the same as that practised by Ayres—viz., that of raising integumental flaps from the abdominal wall, and covering in the bladder by turning the cuticular surface of these flaps towards it. But the details of the operations differ chiefly in this, that the flaps have been taken from the groins and lateral aspects of the abdominal wall, with their bases downwards, so that they might be nourished by the recurrent branches of the common femoral artery.

**Wood's Operation.**—A flap composed of the skin and areolar tissue of the abdominal walls above the extroverted bladder is first dissected up. This flap is somewhat square in shape, and its base should correspond in width with the exposed mucous membrane of the bladder. Its length should be sufficient to cover the whole of the exposed mucous membrane. This flap is turned down with its skin-surface towards the bladder. Then a "pyriform flap," the base of which is about equal in width to the length of the umbilical flap, is dissected up from each groin, the base of the flap being "directed towards the scrotum and thigh" (Fig. 784). These two flaps are brought together so as to meet in the median line, and to cover in the umbilical flap, the raw surfaces of the two groin-flaps being in contact with the raw surface of the reversed umbilical flap. The flaps are then secured in position by hare-lip pins, each pin passed so as to transfix both the groin-flaps and a fold of the umbilical flap beneath, holding the three firmly together (Fig. 785). No sutures are required in the flaps. The edges of the wounds left in the places from which the flaps have been raised are then brought together by hare-lip pins and wire sutures (Fig. 785), and broad strips of plaster placed across so as to support the parts and to remove as far as possible any tension from the flaps. The patient must be kept in bed in a sitting posture, with the knees drawn up.

If the operation be successful, all the pins and sutures may be removed by about the sixth or eighth day, and cicatrisation will probably be complete before the end of a month; the exposed surface of the bladder being completely covered in, leaving only a small opening above the root of the fissured penis, to which an apparatus may be readily adapted to catch the urine. If the umbilical flap be not of sufficient length, very troublesome fistulæ are apt to be left at its angles, requiring further plastic operations for their cure. Experience has shown that, if the operation be left at this stage, the benefit is not permanent. The contraction of the cicatrices, and the constant tendency

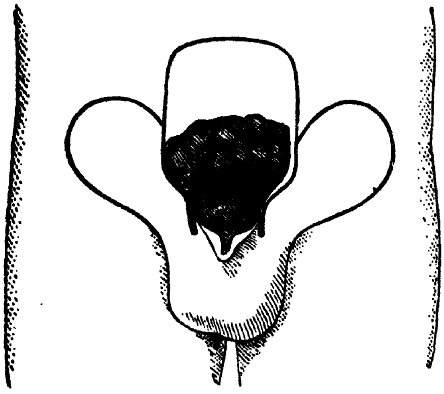


Fig. 784.—Wood's Operation for Extroverted Bladder. Outline of Incisions.

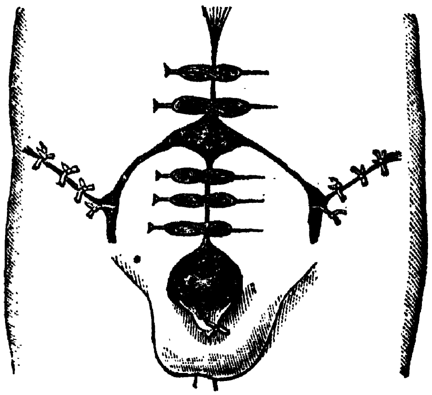


Fig. 785.—Wood's Operation : Flaps applied.

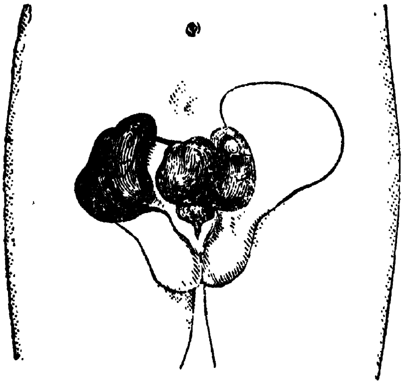


Fig. 786.

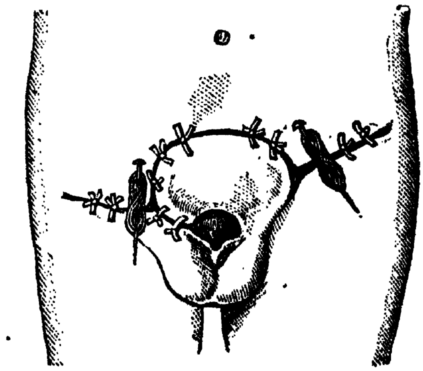


Fig. 787.

Wood's Operation by Lateral Reversed Flaps. (After Wood.)

to protrusion of the mucous membrane of the bladder from beneath the new covering at the opening left at the root of the penis (Fig. 786), lead to a gradual increase in the size of the opening and a partial return of the symptoms. To prevent this, the fissured penis may be covered in by the following method. The whole front of the scrotum, including the dartos, together with the skin covering the lower side of the penis, are raised so as to form a bridge of skin connected with the groin at each side. This is lifted over the penis, and placed upon a raw surface prepared by turning down a collar or flap from the lower arched border of the new bladder-covering and from the sides of the urethra and penis as far forwards as the glans. A continuous wire suture is applied to keep the deep flaps in place; and the transplanted scrotal structures are united to the border of the bladder-covering by a line of interrupted sutures (Fig. 787). The scrotal wound is readily closed by some wire sutures. By this means a sort of urethra is formed, containing the muscular tissue of the dartos in its roof, which may even give it a slight power of contraction, so as to enable the new bladder to retain small quantities of urine. This second stage of the operation is often somewhat interfered with by erections of the penis. These are best controlled by ice-bags. The knees should be kept drawn up so as to relieve tension, especially in the first stage of the operation. After the cure is complete, the patient is often troubled by the growth of hair from the under surface of the umbilical flap, and the accumulation of phosphates upon the hairs and in the angles of the new bladder. This is best relieved by extracting the hairs with a pair of forceps, and by using weak acid injections to remove the accumulation of phosphates.

## CYSTITIS.

Idiopathic inflammation of the bladder is of rare occurrence. This disease most commonly originates either from traumatic causes, as from the passage of instruments, the irritation of broken fragments of calculus, &c.; or it may arise from irritation produced by the application of blisters, the administration of diuretics, or directly from the extension of gonorrhœa to the interior of the organ.

ACUTE CYSTITIS.—The *Symptoms* of cystitis consist not only in local pain and weight about the hypogastric and iliac regions, with tenderness on pressure in these situations, and a good deal of constitutional irritation; but in the existence of extreme irritability about the bladder. So soon as a few drops of urine collect, they excite so much irritation in this viscus that they cannot be retained, and are expelled by a kind of spasmodic or convulsive effort, constituting strangury, often accompanied by a good deal of tenesmus and great suffering. The urine will be found to be high coloured, mixed with more or less mucus or pus, and often tinged with blood.

*Termination.*—An acute attack of cystitis usually terminates in the chronic form of the disease, and thus gradually undergoes resolution. Occasionally, however, it terminates fatally; and when this is the case, the patient's symptoms commonly assume an ataxic character, the tongue becoming brown and dry, the pulse rapid and weak, and the urine very offensive. On examination after death, it will commonly be found that the inflammation of the bladder has gone on to gangrene of the mucous membrane, to diffuse peritonitis, or to the formation of abscess, either in the substance of the wall of the bladder or between the bladder and the rectum, with perhaps infiltration of urine in the deep areolar tissue of the pelvis or the perinæum.

*Treatment.*—The treatment of cystitis is very simple, the disease admitting of little being done in the way of medicines. The free application of leeches to the neighbourhood of the inflamed organ, long-continued soaking in warm hip-baths, the application of poppy fomentations or of laudanum and linseed-meal poultices, the injection of emollient enemata, and the copious administration of barley water or mucilaginous drinks, will subdue the inflammation and afford the patient great comfort; to these means may be added the administration of antimonials with henbane or opiates. The only salines that are of much use are the citrate and nitrate of potash; and these must be given largely diluted.

Chronic Cystitis.—Acute cystitis commonly degenerates into the chronic form of the disease, the symptoms of which closely resemble, though in a modified degree, those that have just been described as characterising acute cystitis, and constitute one of the varieties of the "irritable bladder."

The *Treatment* of chronic cystitis must be of a moderately anti-inflammatory character, so long as inflammatory action keeps up; when once this subsides, and the disease falls into an asthenic condition, the management of the disease must, to a considerable extent, be modified. In the early stages, whilst there is tenderness and inflammatory action, leeches, warm hip-baths, poppy fomentations, mucilaginous drinks, with henbane, and some alkaline remedies, especially the liquor potassæ largely diluted, will be found most useful, the bowels at the same time being kept open by castor-oil and enemata. If there be much strangury of a spasmodic character, it will best be relieved by cupping or leeching the perinæum, the internal administration of chloric ether and opiates, or the cannabis Indica, and the use of morphia suppositories. If the urine become offensive in cystitis, whether chronic or acute, great advantage is derived by washing out the bladder with a solution of the permanganate of potash or of salicylic acid.

Irritability of the Bladder is a condition of very frequent occurrence. It is met with at all ages, complicates many of the diseases to which the urinary organs are liable, and arises from a great variety of causes.

*Symptoms.*—The patient has a frequent desire to pass urine; the fluid is generally ejected forcibly, or even spasmodically, and in small quantities at a time. Its passage is attended by pain of a burning, aching, spasmodic character, then constituting *Strangury*, sometimes confined to the body, sometimes to the neck of the bladder, not unfrequently extending to the point of the penis, or radiating round the pelvis and down the thighs. The urine may in the earlier stages, and in some cases throughout, continue to be healthy; but more commonly, after the disease has lasted some little time, it becomes loaded with mucus, muco-pus, or pus. When the mucoid secretion is abundant, viscid, and glutinous, the affection is called *Vesical Catarrh.* In this stage its duration may be indefinite, more particularly in individuals advanced in years and gouty in constitution.

**Symptoms of Vesical Catarrh.**—In vesical catarrh the symptoms are made up of local irritation and constitutional debility. There is frequent desire to pass urine, which is usually ammoniacal and fetid, and is mixed with a large quantity of glutinous stringy mucus, which gives it a turbid appearance. The urine, on standing, separates into two parts, the upper being clear, but the lower consisting of a thick, viscid, slimy or gummy mucus, often semi-opaque and purulent in appearance; it sticks tenaciously to the bottom of the pot, and when poured out hangs from the edge in long stringy masses. It is often mixed with urinary deposits, more especially of a phosphatic kind. Its microscopic appearances are represented in Fig. 788.

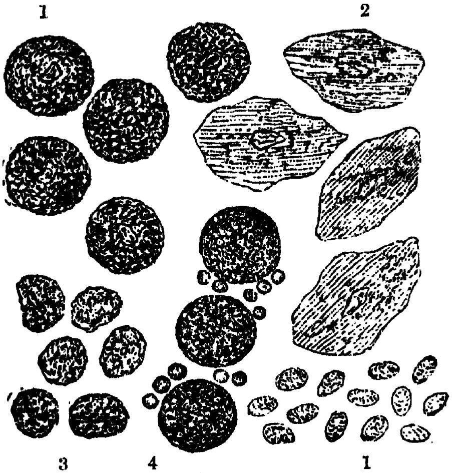


Fig. 788.—Microscopical Appearances in Mucus of Vesical Catarrh. 1. 1. Mucus. 2. Epithelium. 3. Pus. 4. "Organic Globules," met with in the Urine.

The alkaline condition of urine in vesical catarrh has been supposed to depend upon the simple fermentation of its mucus; but Niemeyer and Lister have shown that urine mixed with mucus may continue acid for a great length of time, unless it have become mixed with lower organisms, with vibrios, &c., which Niemeyer has supposed to enter the bladder through badly washed catheters, but which, according to Salisbury, are developed directly from the epithelium of that organ.

This chronic form of inflammation of the bladder is not unfrequently fatal, death resulting eventually with symptoms of a typhoid character; the tongue becoming brown and the pulse feeble; and these conditions are usually associated with uræmic poisoning.

**Pathological Changes.**—On examining the bladder after death in such cases, great thickening of the muscular coat and of the mucous membrane will usually be found, together with a dilated and tortuous condition of the veins ramifying upon it, the blood contained within which is peculiarly black. Abscesses may be found in the walls or outside them, circumscribed and bounded by plastic matter. The mucous membrane is thrown into folds and ridges, which become thickened and hardened, having irregular depressions between them, so as to cause the interior of the bladder to resemble somewhat the inside of one of the cavities of the heart with its projecting columnæ carneæ. This fasciculated condition is almost an invariable accompaniment of long-continued chronic inflammatory irritation of the bladder. As the organ becomes hypertrophied, in consequence of the continuance of the disease, it usually becomes sacculated, the cysts forming at its posterior or lateral parts. The sacculi are of two kinds, both of which are formed by projections between the fasciculi of the wall of the bladder. In the first and least common kind, the muscular as well as the mucous coat is pushed outwards. In the second form of cyst, the mucous coat alone forms a kind of hernial protrusion (Fig. 789). In the cysts thus formed, accumulations of various kinds may take

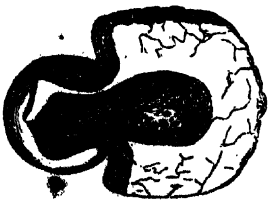


Fig. 789.—Cyst in the Wall of the Bladder.

place: mucus, pus, sabulous matter, and even calculous concretions, not unfrequently being met with in these situations. It is the retention of urine, mixed with mucus or pus in these cysts, where it undergoes decomposition, that is a common cause of the great fetor of the urine in such cases.

**Causes.**—Irritability of the bladder may arise, as has already been stated, from a great variety of causes. These differ somewhat as the disease occurs in men, in women, or in children. The causes of irritability of the bladder in *men* may be arranged under the following heads.

1. *Morbid Conditions of the Urine.*—If this secretion be preternaturally acid and acrid, and loaded with lithates and the products of imperfect assimilation, it is especially apt to occasion an irritation of the bladder, attended by pain and a frequent desire to expel the offending fluid. Urine containing oxalates in large quantity is sometimes, though more rarely, a source of irritability of the bladder, which in these cases is perhaps increased by the morbidly sensitive state of the nervous system usually co-existing with these conditions of the urine.

In *gout*, irritability of the bladder is not unfrequently met with. This may in some cases be owing to the acid and acrid character of the urine; in others, to the excitation of a distinct gouty inflammation of the bladder and prostate, co-existing or alternating with the articular form of the disease.

2. *Renal Disease*, more particularly the lodgment of a stone in the kidney, will often occasion sympathetic pains in the bladder, with much irritability of that organ, so as closely to simulate vesical disease, or even to lead to a suspicion of the existence of stone in the bladder. Tuberculous pyelitis will often occasion irritability of the bladder, so as to closely simulate the symptoms of stone. The presence of the unorganisable deposit in the hilus of the kidney, whether it be tuberculous, or calculous, will produce the same local symptoms, and is not unfrequently attended by sympathetic irritation of the bladder, simulating the presence of stone in that organ.

3. *Disease of the Bladder itself*, as a chronically inflamed state of its mucous membrane, will give rise to pain and irritation on the accumulation of a small quantity of urine, with a frequent desire for its expulsion. So, also, when the interior of the organ is fasciculated, or contains cysts, and more especially if there be a tumour in a state of ulceration, a degree of morbid irritability will be induced, often of the most severe and intractable kind.

4. The *Lodgment of a Stone in the Bladder* will always, by its mechanical action, by its weight and pressure, by rolling about when the body is in motion, irritate the interior of the organ; and, in fact, the "rational symptoms" of stone in the bladder are simply those of irritability of that organ.

5. *Inflammation, Ulceration, Abscess, or other Diseases of the Prostate*, and inflammation, gonorrheal or simple, and abscess or stricture of the deeper portions of the urethra, also not unfrequently occasion irritability of the bladder.

6. *Various Diseases in Neighbouring Organs* will occasion this condition. Amongst the most frequent are fissure and ulcer of the rectum and anus, piles, prolapsus, intestinal worms, gall-stones, and varicocele.

**Diagnosis.**—The diagnosis of irritability of the bladder is easily made; but it is often a matter of no little difficulty, though of the very first importance, to diagnose the precise cause of that irritability. This can of course only be done by a careful *surgical* exploration of the whole of the urinary organs, and often of the neighbouring parts ; no mere inquiry into the nature of the symptoms, no chemical examination of the urine, can do more than establish the fact of the existence of "irritability of the bladder," and afford some evidence of a negative kind as to the absence of certain causes. But nothing short of a careful surgical exploration by means of the catheter, finger, and sound, of the urethra, prostrate, and bladder, can enable the practitioner to state with absolute certainty on what this condition of irritability depends. I have repeatedly seen cases of stone in the bladder, and of prostatic disease, vainly treated by medical means for months as cases of simple "irritability of the bladder ;" the existence of the real cause of the symptoms having been overlooked altogether, until a proper surgical examination of the urinary organs was instituted. So closely, in fact, do the symptoms of vesical irritation, arising from gout, or sympathetic with kidney-disease, simulate those that are occasioned by stone in the bladder, that it is impossible for the most experienced medical practitioner to refer them with certainty to the right cause without exploring this cavity. I have known several patients who had been operated on for stone, and who, some years afterwards, suffered from gouty irritability of the bladder, imagine, but erroneously, that they were labouring under a recurrence of the calculus, so closely do the two classes of symptoms coincide in character.

**Treatment.**—In the treatment of irritability of the bladder it must be borne in mind that this condition is not a substantive disease, but is an assemblage of symptoms resulting from the influence of a great number of very various causes, which must first be removed before the bladder can recover its normal sensibility and tone. When once the occasioning cause has been removed, whether that be a calculus, or gout, or prostatic disease, or a pile, the remaining local vesical irritation may be removed by the use of weak alkaline and mucilaginous drinks. Many sedatives are of use ; some in one case, others in another. Opium and belladonna, either by mouth or in suppository, are amongst the best. Henbane, or Indian hemp, suits some patients ; and chloral is amongst the most generally useful remedies. The diet should be carefully regulated, and warm hip-baths used frequently.

*Cystotomy.*—The disease, when once fairly chronic, may become hopelessly intractable, resisting every means of treatment, local and constitutional ; and nothing can be more miserable than the state of the unfortunate victim of an incurably "irritable bladder." In such extreme and long continued cases in which the patient's life has become a burden to him, in which every constitutional remedy and local sedative has been unavailingly tried, the idea has occurred to Surgeons of incising the inflamed and diseased parts by an operation as for lithotomy. Guthrie, who in 1834 strongly recommended this procedure, states that Sir W. Blizard successfully practised it in several cases as far back as 1806, dividing the enlarged prostate and neck of the bladder with a double gorget. Of late years it has been proposed to make an incision as for median or medio-lateral lithotomy, into the neck of the bladder, and, by introducing a caoutchouc tube, allow the urine to drain away. This operation has proved successful in the hands of Verneuil, and is certainly a proper procedure in hopelessly chronic and otherwise incurable cases.

**Treatment of Vesical Catarrh.**—When vesical catarrh has come on, and the disease has lost its active inflammatory character, appearing rather to consist of atonic exudations from the mucous membrane, a different plan of treatment will require to be adopted. In such cases as these, the greatest benefit will be derived from warm stimulating and balsamic diuretics. Amongst the best are infusion of buchu or matico in large doses. These remedies are useless, unless taken in quantities of a pint or a pint and a half in the day. They may be conjoined with nitric acid and tincture of nux vomica, if the urine be alkaline and the bladder atonic. But no remedy appears to me to possess so much influence over the mere ropy mucoid discharge as the balsam of copaiba. Turpentine, cubebs, and tincture of the sesquichloride of iron, will be found useful. It is often difficult to say beforehand which diuretic will suit best, and I can lay down no precise rules to guide the practitioner in this respect. But they may often be tried or alternated with advantage. In many cases great temporary relief is obtained from each new remedy, which fails to be maintained. In the more advanced forms of the disease, when typhoid symptoms come on, bark and ammonia will be found most useful, together with the administration of the brandy-and-egg mixture. In these cases also it is of great importance to empty the bladder, by means of the catheter, of the viscid mucus that accumulates in it, and the putrefaction of which, together with that of the residual urine, tends to engender the depressed state into which the patient sinks. In some cases, this may advantageously be done by washing it out with warm water injections through a double-current catheter. In this stage of the disease, benefit may occasionally be derived from the employment of slightly astringent injections. Amongst the most useful of these will be found the nitrate of silver, in the proportion of one grain to four or six ounces of tepid distilled water. Brodie employed water slightly acidulated with nitric acid.

**Irritability of the Bladder in Children** appears to be an affection closely allied to the congestive and subacute inflammatory conditions of the different mucous membranes, as of the eyes, nose, and throat, that commonly occur in strumous subjects. In this disease the child passes urine with great frequency and with much pain ; the urine is offensive, and usually phosphatic ; there is much uneasiness complained of about the groins and along the penis ; in fact, many of the ordinary symptoms of stone are present. On sounding the bladder, it will be found roughened, fasciculated, and often contains sabulous matters mixed with mucus. Occasionally there is a good deal of gastro-intestinal irritation, and not unfrequently worms are present.

The *Treatment* consists in attention to the general improvement of the health, in the removal of intestinal irritation, in the regulation of the digestive functions, and in the administration of copaiba in small doses, either alone or conjoined with a few minims of liquor potassæ, at the same time that general antistrumous treatment must be properly carried out, and the bladder washed out from time to time with a weak solution of the nitrate of silver.

**Irritability of the Bladder in Women** often simulates stone so closely, that it is only after very careful sounding that the Surgeon is satisfied that no calculus exists. This condition depends on a morbidly sensitive state of the mucous membrane of the urethra and bladder, that may arise from a variety of causes, similar to those described at p. 844, as occasioning irritability of the male bladder. There are some conditions, however, in which it occurs, that are peculiar to women. 1. It may be a truly neurotic or hysterical affection. 2. It is often sympathetic: being connected with some local disease of the genito-urinary organs, with a vascular tumour at the meatus of the urethra, or with some congestive affection of the uterus, which will require to be cured before the bladder can be brought into a sound state. 3. Prolapsus of the anterior wall of the vagina, drawing down the corresponding portion of the bladder, will keep up this condition; if so, the prolapsus must be cured by some plastic operative procedure. In all circumstances, however, when this state has once been set up, it is very difficult to remove. 4. In many cases it is undoubtedly due to the irritation produced by a morbid state of the urine, dependent on mal-assimilation, and usually connected with an excess of lithates. In cases of this kind, careful regulation of diet, and the administration of potash with henbane, will afford much relief; but the complaint is of a very intractable nature, and under the most careful treatment will often continue for years. 5. In strumous girls it may be due to a congestive, thickened, and irritated state of the vesical mucous membrane, similar to that which is met with in other parts of the body, as the eyelids, nose, and throat. In cases such as these, the patient requires to be put upon a general antistrumous treatment, and the bladder should be mopped out with a very strong solution of the nitrate of silver. This is best done by dilating the urethra, passing a silver tube into the bladder, and then through it a small sponge-probang charged with the solution.

## TUMOURS AND CYSTS OF THE BLADDER; AND HÆMATURIA.

**Tumours of the Bladder.**—The most common tumour of the bladder is the *villous*. This tumour is in no way malignant—in the great majority of cases, being more nearly allied to a papilloma. It consists of numerous delicate branched processes floating freely in the urine. On microscopic examination, each process is found to be composed of a capillary loop surrounded by an extremely delicate connective tissue, in some parts almost homogeneous, with numerous nuclei scattered through it. The surface is covered with epithelium similar in character to that of the bladder. These tumours almost invariably grow on some part of the trigone, and usually near the orifice of one ureter. Fragments of them may occasionally be found in the urine, thus serving as a diagnostic mark of the nature of the disease. They prove fatal eventually by profuse hæmorrhages of a most persistent character, or by the pain they occasion and the obstruction to the escape of the urine, thus leading to secondary diseases of the bladder and kidneys (see Vol. I., p. 763).

True *cancer* of the bladder is very rare, and still more rare as a primary growth. When found, it is almost always the result of extension of the morbid growth, either from the prostate or from the rectum or uterus. The diagnosis is extremely difficult and uncertain. As the cells usually found in carcinoma resemble in many respects the cells of the bladder epithelium, especially those irregular epithelium-cells found in the urine during cystitis, but little value can be attached to the presence of such cells in attempting to diagnose this disease.

Cancer of the bladder is usually associated with similar disease of the prostate or neighbouring structures, and in women may be secondary to cancer of the uterus. According to Walshe, it does not appear before the fortieth year.

These tumours, whether simple or malignant, occasionally become encrusted with *phosphatic* matter, deposited upon them by the urine; and then they will resemble still more closely a calculus when the bladder is sounded; from it, however, they may be distinguished by their fixed character, and by the impossibility of passing a sound around them. Some difficulty is often experienced in examining the bladder in these cases; for, as the fungous mass pushes back the posterior wall of the viscus, it has a tendency to elongate the prostatic portion of the urethra and the neck of the bladder, so that a very long instrument may be required to reach it.

Little can in general be done in the way of *Treatment* in this disease; though the example of Civiale might, in some cases, be advantageously followed, who removed a small growth seated at the neck of the bladder by seizing and twisting it off with a lithotrite. Warner has recorded a case in which a tumour of this kind, of the size of an egg, was tied in the bladder of a woman after dilating her urethra. Billroth has, however, recently successfully removed a villous growth from the bladder of a boy by performing suprapubic and median lithotomy at the same time, and guiding a knife passed in through the perineal wound with his finger inserted at the suprapubic opening.

CYSTS OF THE BLADDER have already been mentioned at pp. 759, 765, and 844, in connexion with stone in and with irritability of that organ. We have now to consider them as a separate disease. As such they may be single or multiple, small in size, not larger than a cherry, or attaining the magnitude of the fœtal head, and even larger than this. They no doubt commonly occur in the bladders of elderly men who have suffered from severe mechanical obstacles to the passage of the urine, in the shape of stricture or enlarged prostate, are associated with a generally thickened fasciculated state of the organ, and appear to be the result of simple dilatation of some weakened spot in the periphery of the bladder by the compression of the contained urine during efforts at expulsion, causing extrusion of the mucous, of the thinned muscular, and of the expanded serous coats at some points of least resistance.

But there is another kind of bladder-cyst, the origin of which cannot be explained in this way, and that would appear to be a distinct out-growth of the bladder. These cysts may be single or multiple, and may attain an enormous magnitude. The largest I have seen occurred in a man 35 years of age, otherwise perfectly healthy. He was admitted into University College Hospital, and was under the joint care of Dr. Wilson Fox and the author. There was a tense elastic tumour, smooth and rounded, occupying the whole abdomen and extending into the pelvis, so as to be felt through the rectum. Had it occurred in a woman, the disease would probably have been pronounced ovarian. The tumour had existed for six months, had gradually increased, but occasioned no uneasiness except by its pressure-effects. There was and had been no difficulty in passing urine or in defecation. The tumour was aspirated at its most prominent part, and seven pints of clear urine were drawn off. The patient suddenly became faint, and died of syncope. On examination after death, two enormous cysts were found connected with the bladder, one on each side, by a rounded opening that would admit the little finger. These orifices were situated symmetrically equidistant from the mesial line, and about one and a half inch above each ureter. These cysts were thin-walled, chiefly composed of mucous membrane and peritoneum, possibly having expanded muscular fibres in their composition. The two cysts were emptied through the bladder by the one puncture. The pelvis of the kidneys, the ureter, and the bladder were all dilated; the urethra and prostate quite healthy. There was a total absence of all mechanical obstruction. It looked as if the whole of the urinary apparatus between the calyces of the kidneys and the neck of the bladder had taken on a dilating outgrowth. For certainly the dilatation of the canals and the formation of the cysts could not be occasioned by excentric pressure, due to mechanical obstruction.

HÆMATURIA.—The admixture of blood with the urine may usually be recognised by the colour that it communicates to this fluid. If the blood be in large quantity, the urine will be dark brown, chocolate, or morone-coloured, and will stain red the bottom of the utensil or a piece of white blotting-paper. If it be in smaller quantity, the urine will be brown in varying shades—smoky, or having something the aspect of thin beef-tea; and in other cases it will be little discoloured, but will deposit a red or brown sediment on standing. Under the microscope, blood-discs may be detected in large numbers. Heat coagulates the blood into a brownish-grey deposit, leaving a clear supernatant fluid.

Hæmaturia may arise from a *constitutional* condition or from a *local* cause. When *constitutional*, it is usually the consequence of scurvy. In those cases it will necessarily be associated with other, and probably marked, evidences of the disease. A form of hæmaturia, depending on the presence of a parasite—the *Bilharzia hæmatobia*—is prevalent in Africa, and has been ably investigated by Leuckart, John Harley, Cobbold, and others.

When arising from *local* causes, hæmaturia is a symptom of disease existing in some part of the urinary apparatus; but it often assumes so great an importance from the loss of blood induced, that it must be looked upon as a substantive disease.

*Sources.*—Hæmaturia may arise from, 1, the Kidneys; 2, the Bladder; 3, the Prostate; or 4, the Urethra; and from each source several distinct causes will produce it. The recognition of the precise morbid condition that gives rise to hæmaturia is of the first importance in its treatment.

1. **Hæmorrhage from the Kidneys.**—When occurring from the kidneys, the bleeding may be the result of congestion, acute inflammation, or malignant disease of those organs, of acute, tubercular, or calculous pyelitis, or of passage of a calculus down the ureter. The most certain evidence that the blood comes from the kidney is the presence of blood-casts of the renal tubules. The renal congestion may be inflammatory or passive; in either case the urine will present, after the discharge of blood has ceased, evidences of chronic renal disease in the form of albumen, pus, or casts of tubes. When the hæmorrhage arises from renal calculus, either stationary or descending, the symptoms of that morbid condition, described in p. 757, vol. II., will be well marked.

2. **Hæmorrhage from the Bladder.**—If the blood proceed from the bladder, it may be the result of congestion of the mucous membrane, of the

irritation of a calculus, of villous disease, or of the ulceration of malignant disease. When it depends on vesical congestion, there will be a sensation of weight in the region of the bladder, with frequent desire to pass urine; when on calculus, the special symptoms of the existence of stone will be present. When it occurs from villous disease of the neck of the bladder, the quantity of blood lost is usually very great and the hæmorrhage is persistent. The blood will be found uniformly mixed with the urine. If it arise from malignant disease, the discharge of pus, and of the *débris* of the ulcerating tumour, will afford unequivocal evidences of the true source of the hæmorrhage.

3. **Hæmorrhage from the Prostate.**—If the prostate be the source of hæmorrhage, the discharge may be occasioned by congestion of that organ, or by its ulceration, simple or malignant. In these cases, exploration by the rectum and urethra will indicate the true cause of the bleeding.

In general, when the hæmaturia is renal, the urine will be uniformly mixed with the blood; when it is prostatic or vesical, the first urine that passes, or that is drawn off by the catheter, will be pale and less bloody than the last, and at the termination of the flow nothing but blood may escape.

4. **Hæmorrhage from the Urethra.**—The bleeding may arise from simple congestion of the mucous membrane, from inflammatory irritation of it, or may follow rupture of the walls of the canal, consequent on injury or on the introduction of instruments.

Blood from the urethra usually flows independently of micturition, as in recent injuries, or passes with the first few drops of urine. It may, however, occasionally come with the last drops expelled. This is by no means uncommon in gonorrhœa, or in cases of gleet dependent upon a granular condition of the mucous membrane of the bulbous portion of the urethra. It seems, then, to be due to the contraction of the ejaculator urinæ squeezing a drop or two of blood from the inflamed spot.

*Treatment.*—The treatment of hæmaturia must necessarily have reference to its cause. When it depends on a morbid constitutional state, as scurvy or malarial poisoning, the treatment of the disease, of which the hæmaturia is merely a symptom or an effect, must be conducted on ordinary medical principles. If it arise from inflammatory congestion of the kidneys, bladder, or prostate, cupping, or the application of leeches over the affected part, demulcents, and saline drinks, will be most efficacious; if from passive congestion, it will usually be found that the hepatic portal system is at fault, and a dose or two of blue-pill or calomel, followed by a purgative, and afterwards by the use of astringents, will speedily induce a cessation of the hæmorrhage. The astringent that exercises the most marked influence in arresting hæmaturia, when that condition is purely passive, is undoubtedly gallic acid. This may be given in five or ten grain doses, frequently repeated, in infusion of buchu or uva ursi.

As a general rule, it is better not to use the catheter in these cases; but sometimes the bladder becomes distended by a large soft coagulum, filling up its interior, and causing it to reach to the umbilicus, forming a rounded solid tumour, like a gravid uterus. In such circumstances, the fluid contents may be drawn off by a large catheter, and the more solid portions broken down and washed away by the injection of tepid water through a large-eyed or double-current catheter. If the syringe of an aspirator be adapted to a large-eyed catheter, the blood, even when coagulated into a single large clot filling the whole bladder, may be easily removed. By the use of this simple contrivance, a complication formerly most troublesome to the Surgeon and most agonising to the patient is overcome without the slightest difficulty. If decomposition occur in the coagulum, giving rise to the formation of flatus in the bladder, a weak tepid saline solution, to which a little creasote has been added, may advantageously be used. I have known abundant hæmaturia to continue for many years—for twelve or fourteen—probably from villous disease, without deranging the general health to so great an extent as might be expected from so continuous and copious a loss of blood.

## ATONY OF THE BLADDER.

**Atony of the Bladder** may occur with the opposite conditions of retention and incontinence of urine, according as there is associated mechanical impediment or the neck of the organ retains or has lost its contractile power. When the body of the bladder is atonic, whilst the neck preserves its contractility, retention of urine will ensue in consequence of simple inability on the part of the organ to expel its contents, and not from the existence of any mechanical obstacle to the outward flow of the urine. When, on the other hand, the neck of the bladder is paralysed, the urine cannot be retained, but dribbles away involuntarily, thus constituting incontinence (p. 855). Atony of the bladder occasionally occurs as the result of a single prolonged over-distension, whether voluntary or involuntary.

Atony of the bladder appears in many cases to depend on simple loss of muscular contractility, and to be altogether unconnected with any diminution of nervous power. The true pathology of this condition has still to be made out. May it not, like the analogous atony of the heart, be due to fatty or granular degeneration of the muscular fibres of the affected organ, and the "flabby heart" have its counterpart in the atonic or "flabby" bladder?

Retention of Urine.—Loss of tone in the body of the bladder, leading eventually to its atony, not unfrequently occurs in old age as the result of simple diminution of muscular power. It must not be confounded with *Paralysis* of the bladder as the result of injury or disease of the spinal cord.

*Symptoms.*—When this condition comes on slowly as the result of disease, the patient usually finds that the urine escapes in a dribbling manner; that there is some difficulty, and at last an impossibility, in emptying the bladder completely; and there is not that forcible ejection of the last drops of urine that is characteristic of a healthy tone in the organ; at the same time, there is not unfrequently a tendency to the dribbling away of a few drops towards the end of the emission of urine, and after its apparent cessation. There is also an occasional escape of urine at night. When complete retention occurs, whether this take place gradually or suddenly, the bladder slowly enlarges, rising at last out of the pelvis into the abdomen, stretching up into the hypogastric region, reaching even as high as the umbilicus. On examining the lower part of the abdomen, the organ will be felt hard, elastic, rounded, and pyriform in shape, projecting above the pubes, and feeling much like an enlarged uterus. In this situation, also, percussion will elicit a dull sound ; and on exploring the part through the rectum, the bladder will be found to project in this direction also ; and on tapping with the fingers above the pubes, fluctuation may be felt through the wall of the gut.

Atony of the bladder is a sufficient cause for incomplete retention of urine. But it does not appear to me to be adequate to explain the complete retention with distension of the bladder that is commonly seen. For this to occur there must be some mechanical obstacle, however slight, to the outward flow of the urine—contraction of the neck, or a congested or enlarged prostate. Could complete retention occur from a merely atonic bladder, we should meet with it in women as well as in men. But simple atony of the bladder is a cause of incontinence, not of complete retention, in the female. It is the mechanical obstacle at the neck of the male bladder which intensifies the effects of its atony and leads to the complete stoppage.

After the bladder has once become distended, it commonly happens that a quantity of urine continues to dribble out of it ; in fact, the amount that escapes in this manner may be very considerable, though the retention continue unrelieved. This *retention with dribbling* is a condition of much practical importance, as the continued escape of urine may lead the patient, and even the Surgeon, to overlook the true nature of the disease ; the more so, as in elderly people retention slowly induced often occasions but little inconvenience. I have drawn off nearly a gallon of urine from a patient in whom it had not been suspected that retention existed, in consequence of the continuance of this dribbling. In women, retention is not by any means so common as in men, but the bladder will sometimes attain an enormous size, rising as high as the umbilicus ; and such large bladders have been tapped under the supposition of the tumour being an ovarian cyst, or some similar growth. I once witnessed such a case in which the Surgeon, to his surprise, on tapping the tumour, drew off a quantity of clear and healthy urine, instead of ovarian fluid ; fortunately no bad effects followed. This retention with dribbling occurs in consequence of the bladder, as it rises out of the pelvis, elongating its neck ; and as the body becomes bent forward over the pubes a sharp curve or angle is formed at the junction of the neck and body of the viscus, through which a small body of urine continues to dribble away, and escapes rather by its own gravity than by any expulsive effort on the part of the patient.

*Diagnosis.*—Retention from *Atony* can easily be diagnosed from retention from *Obstruction.* In the former, on introducing the catheter when the patient is lying on his back, the instrument will not only readily enter, but the urine will simply flow out in a slow uniform stream, not being projected in a jet by the contraction of the walls of the organ, but rising and falling in obedience to the respiratory movements. In retention from obstruction, there will be experienced some difficulty in passing the instrument at some one point ; and when once it is introduced into the bladder, the urine will escape in a free and far projected stream.

*Results.*—The habitual retention of a small quantity of urine in an atonic bladder which is incapable of discharging completely the whole of its contents occurs much more frequently than is suspected. The quantity thus retained will vary from an ounce to half a pint: the patient believing that he has emptied his bladder, but the introduction of a catheter proving the existence of retained urine. This condition will be a source of serious inconvenience, and eventually of disease, to the patient. In consequence of the bladder never being completely emptied, there will be frequent, sudden, and almost irresistible calls to pass urine, so as to simulate irritability of the bladder. The retained urine becomes offensive, ammoniacal or fishy in odour, and mixed with mucus or muco-pus. The constituents of the urine become absorbed, derange the health, give rise to impaired nutrition, and, being eliminated by the skin, irritate it and occasion intractable forms of skin-disease. I have seen chronic eczema of the most inveterate character produced in this way, and only yield to treatment on care being taken to keep the bladder clear and free from residual urine. The continuance of complete retention of urine from atony of the bladder, will probably give rise to fatal consequences; a subacute inflammation taking place in the mucous membrane of the organ, which falls into a sloughy condition, accompanied by symptoms of a typhoid type. In some instances coma supervenes, owing to the poisoning of the system by the absorption of the urinary constituents. Even though the retention be relieved, this condition is apt to come on; vesical catarrh with fetid urine supervening, the tongue becoming brown, and low fever setting in. The bladder cannot ulcerate or burst when the retention arises from atony of that organ independent of any mechanical obstacle; the continued dribbling preventing this catastrophe.

*Treatment.*—The treatment of retention from atony must have reference to the cause of the loss of power in the bladder; but in all circumstances the urine must be drawn off regularly. A large gum catheter must accordingly be introduced twice a day, even though the retention be not complete, in order to empty the bladder of the small quantity of residual urine left in it after the apparent evacuation of its contents; and, in doing this, care must be taken that the beak of the instrument properly enters the body of the bladder, which is further removed from the pubes than usual; for it will sometimes happen that it may enter the dilated prostatic part of the urethra, or elongated neck of the bladder, when, an ounce or two of urine escaping, it may be supposed that there is no more left, though in reality the viscus is immensely distended. In order to get the catheter well in, its point should be closely hooked around the pubes and raised by depressing the handle between the thighs. In cases of paralysis, the catheter should neither be introduced too frequently, nor should it be allowed to remain in the bladder. Frequent introduction of the instrument, or its retention in the bladder, is liable to be followed by subacute cystitis, with fetid, ammoniacal, and viscid urine.

These sequences are usually attributed to the mechanical irritation produced by the instrument giving rise to low inflammation of the vesical mucous membrane, and this occasioning in its turn a decomposition of the urine. That a solid and foreign body like a catheter may, by its repeated introduction into and retention in the bladder, develop irritative inflammation of the interior of this organ, is by no means improbable. But I cannot consider this to be the sole, or, indeed, the chief cause of the urinary disturbance that ensues.. It would appear probable that the air which is carried into the bladder at each introduction of the empty catheter, gives rise to decomposition of the urine; that this becoming ammoniacal, decomposed, and fetid, irritates the mucous membrane of the bladder; that vesical catarrh then results; and that thus we have the phenomena of decomposed urine, subacute cystitis, and vesical catarrh, occurring in the consecutive order just given, and primarily arising from and dependent on the introduction of air, and consequent putrefaction of the urine. The pressure of the point of a catheter retained in a paralysed bladder may also give rise to sloughing of the mucous membrane.

When once a bladder has become atonic, it very rarely recovers its contractility completely. The regular use of the catheter becomes imperative, and will do more, by taking off the habit of retention, to favour normal contractility, than any medicines. The only internal remedy of any real value is strychnine, in very minute doses, long continued.

The treatment of an enormously distended bladder with concurring extravasation into, and abscess of, the perinæum, is very simple. It consists in putting the patient in the lithotomy position, introducing the left forefinger into the rectum, thrusting a long bistoury, edge upwards, into the mid-line of the perinæum, until it reaches the open space occupied by pus and urine, cutting upwards for about three inches, and thus opening up the perineal suppuration and extravasation, and evacuating the over-distended bladder through the incision thus made. The double pathological condition is thus relieved by one simple free incision. After the operation, an elastic catheter may be passed by the urethra into the bladder, the end left open, attached to an India-rubber tube, and the urine thus allowed to escape.

INCONTINENCE OF URINE arises from weakness of the neck of the bladder, in consequence of which there is not sufficient power to hold the contents of the organ, and the urine escapes. It may be regarded as active or passive, according as the body of the bladder retains or has lost its contractile power.

**Active Incontinence** is most frequent in children, in whom it occurs during sleep, the patient losing command over the sphincter so soon as a small quantity of urine has accumulated behind it. In many cases it is sympathetic, dependent on the irritation of piles, stricture of the urethra, or stone in the bladder; and occasionally it results from nervous causes, more particularly in women of a hysterical temperament. In strumous children, nocturnal incontinence of urine is very apt to occur; probably from the irritation produced by the fluid, which is generally found loaded with uric acid crystals.

**Passive Incontinence**, or, as it has been termed by Thompson, *overflow* of urine, occurs when the bladder is in a state of atony. In such cases, the sphincter-like action of the neck may not be quite lost, so that a small quantity of urine is ejected from time to time, as it overcomes the slight resistance offered by the partial contractility of the neck. Over-distension of the bladder will occasion incontinence of urine, not from paralysis, but from a kind of strain of the muscular structures of the part: in this way a patient, who from circumstances has been unable to empty his bladder for a considerable time, may suffer from incontinence. Incontinence or overflow is also liable to occur in cases of enlarged prostate; being here preceded by distension (see page 864). In old people it may occur from simple debility, and is commonly associated with a tendency to retention.

*Treatment.*—The treatment must depend upon the cause. When the incontinence occurs in weakly children, if it be not connected with worms or gastro-intestinal irritation, which should then be removed, the administration of tonics will be found useful—either quinine or the tincture of sesquichloride of iron, alone or conjoined with tincture of cantharides. If there be irritation of the mucous membrane of the bladder, the administration of alkalies, in conjunction with a tonic, as the potassio-tartrate of iron, or a little copaiba mixed with honey, will be found very serviceable. Cold sponging, light clothing at night, and means calculated to break the habit, such as waking the child at the time at which it generally occurs, changing his position in bed, &c., should not be omitted. Of all remedies for incontinence of urine in children, belladonna is the most successful. Ringer advises it to be given in full doses; from 10 to 20 minims of the tincture three times a day. When incontinence occurs at a more advanced period of life, if there be any source of sympathetic irritation, this must be removed: if none can be discovered, recourse must be had to tonics, especially iron and cantharides with strychnine, and galvanism, together with cold douching or shower-baths, and in old people the daily use of the catheter.

**Hysterical Retention and Incontinence of Urine** not unfrequently occur in nervous girls, and require to be treated by antihysterical remedies, amongst which preparations of sesquichloride of iron, either alone or with valerian, will be found most useful. Cold douches are also of great service. In cases of hysterical retention, it may sometimes be necessary to use the catheter; but in such circumstances it is well not to employ this instrument too frequently, as the patients are apt to get into the habit of having it introduced, and will, with that morbid propensity that characterises hysteria, continue for a length of time to require its introduction. If left to themselves, though the bladder may become much distended, it will not burst, but will probably empty itself without further trouble, particularly if the patient be put into a tub and well douched over the hip and loins with cold water. In some cases, these morbid conditions in women appear to be connected with some local irritation about the urethra or uterus; and then proper treatment must be directed to these organs before the disease can be removed.

PAINFUL CONDITIONS OF THE BLADDER.—The bladder may be the seat of severe pain, either continuous or remittent, without any disease being discernible in it on the closest examination; the pain being either a kind of neuralgic condition, especially occurring in hysterical or hypochondriacal patients; or else being sympathetic with, and dependent on, disease at a distance, as in the kidneys, uterus, rectum, &c. At the same time it must be borne in mind, that the secretion of acid or irritating urine will, in some individuals, be a source of much and constant suffering; and that any disease seated about, or coming into contact with, the neck of the bladder, as tumour, stone, &c., is especially apt to give rise to severe suffering, and will, in many cases, be accompanied by frequent desire to micturate, with much spasm about the part.

# CHAPTER LXXI.

## DISEASES OF THE PROSTATE.

The prostate is subject to Acute and Chronic Inflammation, to Hypertrophy, and occasionally to Atrophy, Malignant Disease, Tubercle, and the formation of Calculi.

### PROSTATITIS.

**Acute Inflammation of the Prostate, or Prostatitis,** very rarely occurs as an idiopathic affection. When met with, it is usually the result of gonorrhœa, or of the use of stricture-instruments, more especially in middle-aged men.

*Symptoms.*—These are—deeply-seated dull pain, with heat and weight in the perinæum, a frequent desire to pass urine, and very great and spasmodic pain accompanying the act; in fact, the irritability that is set up about the neck of the bladder is perhaps the most marked and distressing feature in the disease. These symptoms are, however, common to various inflammatory affections of the urinary organs, and they can only be distinctly referred to the inflamed prostate by rectal exploration. On introducing the finger into the gut, the prostate will be found much enlarged and exquisitely tender to the touch; and the patient often suffers considerably from the pressure of the inflamed organ upon the rectum during defecation.

*Treatment.*—This should be of an active antiphlogistic character, so as to prevent, if possible, the formation of abscess. The perinæum must be cupped or well leeched; warm hip-baths and poppy fomentations assiduously employed; and salines with antimony administered. In this way, the formation of abscess within or around the prostate may, in many cases, be prevented.

**Prostatic Abscess** may happen either as a consequence of acute inflammation running into the suppurative stage, and in this way it is not very unfrequently met with as a complication of gonorrhœa; or it may occur with comparatively little antecedent inflammation—as sometimes happens in pyæmia, or if the organ be accidentally bruised during lithotrity. In these cases, abscess perhaps as frequently forms in the areolar envelope as in the organ itself. Idiopathic suppuration of the prostate, irrespective of any of the above causes, is, however, of rare occurrence; but it may occur in individuals of broken health, the matter then usually accumulating in large quantity, and discharging itself into the bladder.

*Symptoms.*—When inflammation of the prostate terminates in abscess, rigors, with strangury, and perhaps retention of urine, occur. In many cases the perinæum becomes brawny; in others, tenderness of the gland and deep fluctuation may be felt through the rectum. When left to itself, the abscess most usually gives way into the urethra or neck of the bladder; but it may, especially when occurring in the prostatic capsule, open externally into the perinæum, or even into the rectum. In many cases, the abscess presenting on the urethral surface of the prostate is burst during the introduction of the catheter, used for the relief of the retention of urine induced by the pressure of the tumefaction; the matter escaping along the side of and through the instrument.

*Treatment.*—It not unfrequently happens that the first certain indication afforded to the Surgeon of the formation of a prostatic abscess is the escape of pus by the urethra, or mixed with the urine, so as to give this fluid a thick milky appearance. In such circumstances, the only available treatment is that which is directed for the relief of the strangury and local vesical irritation on ordinary medical principles, such as have already been described. But if, as sometimes happens, the pus come forward into the perinæum, then a more decided line of treatment is required. In these cases a hard brawny mass will be felt lying deeply on the side of the perinæum; and into this a deep incision should be made. The Surgeon must not wait for fluctuation, but must cut deeply in the direction of the matter, keeping, however, as nearly as possible in the mesial line, with the back of the knife towards the rectum. Even if no pus escape at first, it may do so if the part be well poulticed for a few hours; and thus communication with the urethra or rectum may be prevented.

**Retention of Urine from Prostatitis.**—In prostatitis, retention may occur from the swelling of the organ, from the infiltration of exudation-matter around it, or from the formation of pus in it. In these cases the neck of the bladder will be carried to a considerable distance from the surface, and may very probably not be reached by an ordinary catheter, which may be buried up to the rings and yet not enter the cavity of that organ. In these circumstances a silver prostate-catheter should be employed; and this must be carefully introduced, lest, by entering the cavity of an abscess which has already burst *per urethram*, it might be supposed to have entered the bladder itself. In introducing the instrument in these circumstances, care should be taken to keep its point constantly in contact with the upper surface of the urethra, and to hook it round the pubes. The *upper* surface of the urethra is a sure guide to the bladder; for any abscess, false passage, or irregularity of direction will always first affect the lower aspect of this canal, being surrounded by yielding structures; whilst the upper part, being firmly supported by bone and ligament, cannot so readily alter its direction.

**Deep-Seated and very Chronic Abscess** will sometimes slowly form in the pelvis, between the bladder and rectum, or behind the prostate, giving rise by its pressure to a long train of obscure symptoms, indicative of irritation about these organs, such as dysuria, strangury, occasional admixture of pus with the urine. On careful examination of the perinæum and rectum, some slight hardness may perhaps be deeply felt in the mesial line, or towards one side of it. This slowly increases, and perineal abscess of an ill-defined character developes itself. When this has become sufficiently evident, a free incision should be made into it, when pus in greater or less abundance will escape. On careful exploration by a probe of the cavity thus opened up, a deep sinus will probably be found leading into the pelvis, and to the original seat of the abscess. This requires to be opened up by a free incision on one side or other of the perinæum, as if for lateral lithotomy, and a proper and direct exit given to the matter. The cavity must then be dressed with dry lint, and allowed to granulate from the bottom.

### CHRONIC ENLARGEMENT OF THE PROSTATE.

**Chronic Enlargement of the Prostate** may be looked upon as a senile disease, seldom occurring before the age of fifty-five, and being commonly met with after this. At that period of life, as Brodie observes, when the hair becomes grey and scanty, when atheroma begins to be deposited in the coats of the arteries, and when the arcus senilis forms on the cornea, the prostate often becomes increased in size. At the same time, however, other changes take place in the genito-urinary system; thus the urethra becomes dilated and the bladder thickened; and, unless the enlargement of the prostate advance in too great a proportion to the other changes, so as to interfere with the free escape of the urine, no disease can properly be said to be established. If we look upon the diseased enlargement of the prostate as such an amount of hypertrophy of this organ as interferes seriously with the discharge of the urine, we shall probably not find it so frequent even in old men as is generally supposed. Guthrie states that it is not commonly found in the pensioners at Greenwich Hospital. Thompson found that an enlargement appreciable after death existed in 34 per cent. of men above the age of sixty; but that such a degree of enlargement as to give rise to symptoms during life was only met with in 15 or 16 per cent. of the cases he examined. Though age must be looked upon as the primary cause of this particular hypertrophy of the prostate, there can be little doubt that it may be predisposed to by any continued source of irritation of the urinary organs, such as gonorrhœa, stricture, or hard living.

CHARACTERS.—Enlargement of the prostate is due to hypertrophy of the normal structures—fibrous and glandular—of the organs. Most commonly there is an excess of development of the fibrous structure; generally, however, when the size of the gland has been very slowly and not greatly enlarged, there is nearly equal hypertrophy of all the tissues. In rare instances, there is excessive development of the glandular element; and in some cases homologous tumours are developed. The enlargement generally occupies the whole of the organ, and may cause its size to increase to that of a hen's egg or a small orange; in most cases, all the lobes are enlarged equally or nearly so, but sometimes there is a greater development of one of the lateral lobes or of the middle portion. More rarely, the lateral lobes or the anterior commissure alone are enlarged.

The enlarged prostate, in the earlier stages, presents to the naked eye an appearance of rotundity and increased fulness: at a more advanced stage, there may be great irregularity of outline. There is usually no change of colour externally: and the texture of the gland is generally indurated, though sometimes it is found to be looser and softer than natural. On making a section, the cut surface bulges above the level; and the shades of colour are more strongly marked than in the healthy prostate. Not uncommonly, single gland-lobules are found hypertrophied; and in some cases, spheroidal prominences are seen, which are easily enucleated, and which are tumours formed in the substance of the gland. Of these we shall presently speak. In some instances, an abundance of fluid escapes from the cut surface and from the openings of the prostatic ducts; while in other cases this is entirely wanting. Small cavities, dilatations of the gland-follicles, are occasionally found; sometimes empty, and sometimes containing a yellow fluid resembling pus in appearance, but which consists of the prostatic secretion in a thickened state. The prostate may attain a very large size. The largest that I have seen is certainly one in the Norwich Hospital Museum, taken from a man of eighty; it weighs more than 20 ounces.

**Simple Prostatic Tumours.**—The nature of simple tumours of the prostate has been carefully studied by Sir Henry Thompson; to whose elaborate work on the diseases of this organ the student is referred for further information. According to Thompson, tumours of non-malignant character are met with in most cases of hypertrophied prostate, and also occasionally when there is no enlargement of the organ. He divides them into two classes.

"1. Tumours which are generally imbedded in the substances of the prostate, but the structures of which are isolated from those which surrounded it.

"2. Outgrowths which are continuous in structure with the parts of the prostate whence they spring, but which manifest a tendency to become partially isolated, by assuming a more or less polypoid form, and maintaining attachment to the parent organ through the medium of a pedicle only."

1. The *isolated tumours* in the substance of the prostate have been recognised by Sir E. Home, Cruveilhier, Rokitansky, Paget, and other pathologists. They may occupy any portion of the organ; but are, perhaps, more numerous in the lateral lobes than elsewhere. They are easily enucleated, having but a loose connection with the substance of the gland. In diameter they vary from $\frac{1}{10}$th to $\frac{5}{8}$ths of an inch. They are firmer and mostly paler in colour than the proper prostatic tissue, and are less vascular.

"The basis of the tumours appears to be the fibrous basis or stroma of the prostate itself, an admixture of unstriped, soft, pale muscular fibres, and connective with a little elastic tissue, closely interwoven. Interspersed with this, there are present in most cases small cavities containing flattened polygonal or spheroidal epithelium, like that seen in a pouch at the extremity of a prostatic gland-duct, and sometimes, also, some prismatic epithelium. These cavities are sometimes solitary, sometimes slightly branched, and sometimes of an elongated or tubular form. In a few instances there is very little, or, perhaps no such glandular tissue to be found; generally, however, a careful search will discover it. In some of the outlying tumours the glandular structure is more perfectly developed—in some it is quite so—and a duct is furnished which evidently carries secretion to the appointed destination."

2. The part of the prostate which is most usually the seat of *outgrowth* is the middle or urethral portion, which may become greatly enlarged in size, with or without hypertrophy of the lateral lobes. The growth assumes a pyriform

shape, and is more or less pedunculated. It is continuous in structure with the prostatic tissues, and has its own duct, which opens into the urethra through the pedicle. Prostatic concretions are commonly found in these outgrowths; never in the isolated tumours.

Outgrowths are most common in the middle portion of the prostate; but sometimes there may be a projection from the posterior part of one of the lateral lobes, or from that portion of the gland which lies above or in front of the inner orifice of the urethra.

In rare instances, the verumontanum alone appears to be affected, forming a thickened polypoid projection, which projects in a valvular manner, and interferes materially with the flow of urine.

Thompson points out, as had been suggested by Velpeau, that remarkable analogies exist between these prostatic outgrowths and the fibroid tumours of the uterus. This view is in accordance with the teaching of Leuckart, Simpson, and others, that the prostatic utricle in the male is the analogue of the uterus in the female.

**Mechanical Effects of Enlarged Prostate on the Urinary Organs.**—Enlargements of the prostate are productive of inconvenience with regard to the flow of urine, giving rise either to retention or to incontinence, or to a kind of mixture of both conditions. When the lateral lobes are enlarged, there is a diminution of the lateral or transverse diameter of the canal, at the same time that the antero-posterior diameter is increased, so that the canal becomes a chink-like passage. The urethra also becomes greatly elongated and tortuous; and is diverted from the natural direction—this varying with the form of enlargement. When the median portion is enlarged, there is a more or less angular curvature of the canal at the prostatic portion. When, in addition, there is enlargement of a lateral lobe, the urethra is also curved laterally in the direction of the enlarged lobe. The lateral deviation may occur also when there is enlargement of the middle lobe; but it then affects both sides.

The inner orifice of the urethra also undergoes changes. Enlargement of the posterior part of the middle portion of the prostate gives it a crescentric form, with the convexity directed upwards: and, in enlargement of either lateral lobe, the convexity of the crescent lies towards the side opposite the enlarged lobe. Sometimes, when there are two or more irregularly enlarged lobes, the orifice is very much distorted, elongated, and tortuous. Sometimes, in cases of valvular or pedunculated projections from the posterior portions, the orifice appears to be overlapped altogether. This condition existed in the case from which the accompanying (Fig. 790) was taken; the third, or median lobe forming a pedunculated tumour which acted like a valve—obstructing the exit of the urine from the bladder, though it did not offer any obstacle to the introduction of a catheter.

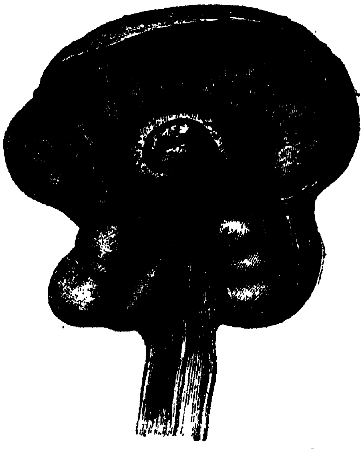


Fig. 790.—Bladder laid open, showing Enlargement of Urethral Portion of Prostate.

The elongation and expansion of the prostatic portion of the urethra gives rise to an increase in its capacity, so that it sometimes holds two or three ounces of urine; and the elongation will carry the neck of the bladder upwards and behind the pubes, to a considerable distance from the urethra.

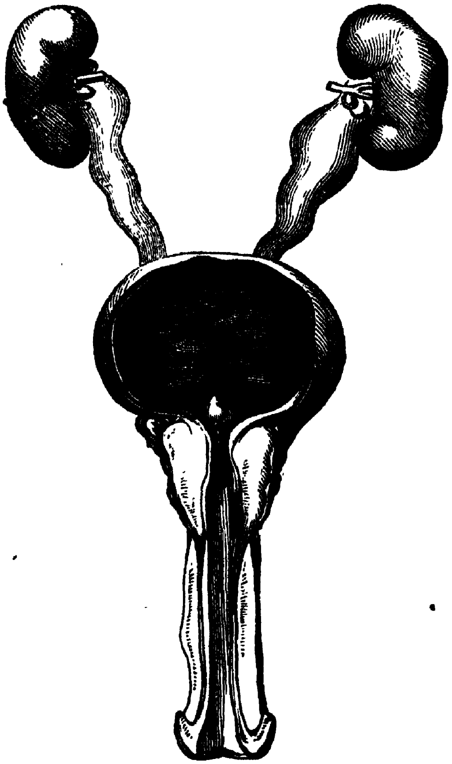


Fig. 791.—Results of enlarged Prostate; Bladder enlarged: Ureters dilated; Chronic Disease of Kidneys.

While the lateral enlargements cause the urethra to assume a somewhat tortuous course, the middle lobe, if hypertrophied, may readily occasion retention, by projecting against the entrance to this winding channel, and falling over it like a valve whenever the patient attempts to pass urine, as in Fig. 790. Then, again, if the middle lobe continue small whilst the enlargement of the lateral lobes takes a direction up towards the bladder, widening as they go, the vesical neck may be so dilated that incontinence and a continuous dribbling will occur through a kind of fissure that extends between the lateral lobes.

The obstacle offered to the passage of the urine by an enlarged prostate will usually eventually give rise to a chronically thickened, fasciculated, and sacculated bladder, the fundus of which descends below and behind the enlarged gland, forming a kind of pouch that cannot empty itself, and in which mucus and morbid concretions are apt to collect. The ureters often become dilated and the kidneys chronically diseased; a series of changes well illustrated by the annexed cut (Fig. 791).

**Moral Effects of Enlarged Prostate.**—The irritation of a congested and enlarged prostate will excite libidinous ideas in the aged, which may lead to the perpetration of acts of indecency—such as exposure of the person, &c., or to a general impairment of the moral tone. But not only does the diseased state of this body thus excite a depraved condition of the mind; the converse will also happen. And if the true history of many cases of prostatic congestion and hæmorrhage were told, it would be found to begin in undue or irregular sexual or erotic excitement, by which the genital organs have been injuriously over-stimulated.

SYMPTOMS.—The symptoms of enlarged prostate arise primarily from the mechanical obstacle offered to the escape of the urine. The first symptoms usually consist in the feeling of a necessity to strain slightly before the urine will flow; and then, after the bladder has been apparently emptied, in the involuntary escape of a small quantity of urine. The patient also finds that he is much longer than usual in emptying the bladder; for, though the stream flows freely enough so soon as it has once begun to escape, yet it cannot be properly projected, the viscus having, to a certain extent, lost its tonicity.

About this time changes begin to take place in the urine, which usually becomes somewhat fetid, even while it continues acid, and is often intermixed with more or less viscid, stringy mucus; though in many cases it is clear, pale, and not in any way altered in character. The symptoms often come on in a very gradual manner, the patient straining and experiencing much difficulty in the extrusion of the urine for months or even years before retention will occur. As the disease advances and the bladder becomes less capable of emptying itself, two or three ounces or more of residual urine are left, which becomes dark, and mixed with adhesive sticky mucus; and, at last, if the mucous membrane of the bladder fall into a chronic state of inflammation, this urine assumes a milky appearance from an admixture of pus, and becomes horribly offensive, blackening the silver catheter.

DIAGNOSIS.—The exact condition of the enlarged prostate can only be ascertained by examination through the rectum and urethra. By rectal exploration with the finger, the degree of enlargement of the lateral lobes can best be ascertained; though, as in many cases the end of the finger cannot reach the further extremity of the gland, it will be impossible to say to what extent the hypertrophy has extended. The urethral exploration must be conducted by means of a long gum-elastic or a silver prostatic catheter, and will afford information that rectal exploration cannot give; and by it are ascertained approximately the size of the middle lobe, and the condition of the urethra as to elongation and curve.

The diagnosis of obstruction in consequence of enlarged prostate has to be made from that produced by, 1, Stricture of the Urethra; 2, Calculus of the Bladder; 3, Vesical Tumour: 4, Chronic Cystitis; 5, Atony of the Bladder; 6, Paralysis of the Bladder.

1. In *Stricture* the stream of urine is small; the obstruction is within six inches of the meatus; and the disease mostly occurs before middle life. In enlarged prostate, the flow of urine is not always reduced in volume; the obstruction is at least seven inches from the orifice; and the enlargement does not occur until after middle life.

In stricture, straining will increase the jet of urine; in enlarged prostate, it only makes matters worse.

2. *Calculus* presents many symptoms in common with enlarged prostate, and its more special symptoms may be absent. The presence of a small quantity of florid blood in the urine passed after exercise should make the Surgeon strongly suspect the presence of a stone; but the use of the sound will alone lead to an exact diagnosis.

3. *Vesical Tumour* gives rise to more pain and tenderness on the introduction of instruments than prostatic enlargement; and the urine generally contains sanious discharge and flocculi, often with sabulous matter. Microscopic examination of the contents of the urine may show the presence of the component tissues of the tumour. Tumours, especially of the malignant kind, may be felt through the rectum; while villous tumours give rise to the almost constant presence of blood in the urine.

4. In *Chronic Cystitis*, without complication, the absence of the physical signs of enlarged prostate, as ascertained by examination by the rectum and urethra, will establish the diagnosis.

5. In *Atony* of the bladder from over-distension, the diagnosis is effected by observing the manner in which the urine flows on the introduction of a catheter. In prostatic obstruction—provided that the distension have not produced atony—the flow of urine is often forcible, and can be accelerated by the will of the patient ; while, in atony, the urine simply runs out through the catheter.

6. True *Paralysis* of the bladder, accompanied with a similar affection of other parts, is recognised by its concomitant conditions, and by the absence of physical signs of enlarged prostate, and, as in atony, by the passive nature of the flow of urine through the catheter.

**Retention of Urine** constitutes the great danger in advanced cases of enlarged prostate. It commonly comes on gradually, the patient having for some time before experienced considerable difficulty in passing his urine, and he will often find that the more he strains in his efforts to do this the less readily will it come away ; whereas, when he remains quiet, it will usually flow with more freedom. The retention from prostatic enlargement is of the mixed kind, there being always more or less incontinence, or rather overflow, conjoined with it. When the bladder has become tense, and the prostatic portion of the urethra put upon the stretch, the escape of a certain quantity of urine will take place, until, by the relief of the tension of the over-distended bladder, the parts about its neck and the enlarged prostate become relaxed, so that they again fall together, and thus, the urethra resuming its tortuous condition, the outlet is occluded. In these cases error may always be guarded against by the Surgeon feeling the enlarged bladder rising up above the pubes, and reaching perhaps as high as the umbilicus. This condition is an extremely dangerous one, not so much from any risk of the bladder or urethra giving way in consequence of over-distension, which very rarely happens in retention from enlarged prostate, as from the occurrence of atony of the bladder, or the probability of the early setting in of chronic inflammation of its mucous membrane, which is especially apt to take place. The bladder has usually not emptied itself completely for a considerable length of time before the retention is complete ; and a quantity of ropy mucus, having collected in the fundus behind the prostate, whence it cannot be expelled, becomes putrid, and thus disposes to the supervention of that form of chronic inflammation of the vesical mucous membrane, which, occurring in a depressed state of the system, is especially apt to give rise to a brown tongue with quick pulse, and typhoid symptoms. Secondary inflammation of the kidneys terminating in suppuration is of frequent occurrence. Indeed, when death occurs from prostatic disease, it usually takes place in this way.

In some rare instances there is evidence of true incontinence of urine, the bladder being found empty and contracted, while the prostate is enlarged considerably but equally, so that the urethral orifice is patent.

TREATMENT.—In the treatment of enlarged prostate, little can be done by medical means ; though the patient's condition may be somewhat ameliorated by remedies calculated to lessen irritation about the urinary organs, and to improve the condition of the urine. If it be very acid, alkalies with henbane should be given ; if neutral or alkaline, the dilute nitric acid with opium ; if mixed with ropy mucus or muco-pus, the infusion of buchu, or the balsams of copaiba or Peru, or turpentine. If hæmorrhage occur, tincture of sesquichloride of iron, infusion of uva ursi, or gallic acid, will be useful. Counter-irritation, the application of iodine, and other measures calculated to promote absorption of the enlarged gland, are of service.

In the treatment of enlarged prostate, it is of great importance to use the catheter regularly, in order to empty the pouch that forms in the *bas fond* of the bladder behind the prostate; and which, being below the level of the urethra, tends to collect an accumulation of viscid mucus and fetid urine which the patient cannot expel without aid, partly from their gravitating into this pouch, and partly from the muscular power of the organ being impaired. The removal of these matters is of great importance; as, independently of any retention, they may, by undergoing putrefaction, give rise to septic infection. The bladder should be effectually emptied at least twice *every day*. This may best be done by the introduction of a gum catheter of full size, which should be passed without the stylet. This the patient should be taught to do himself; and thus the habitual distension of the bladder, or retention in it of a quantity of urine, will be prevented, and all the accompanying constitutional disturbance averted. Sometimes, in order to reach and empty the bladder thoroughly, a prostatic catheter must be used. This instrument should be made of silver, and be of large size, equal to about No. 12. In order to properly enter the bladder, which is carried away from the surface by the elongated urethra, the prostatic should be about four inches longer than an ordinary catheter; and, as the neck of the viscus is usually pushed up high behind the pubes by the projection upwards of the lateral lobes, the curve of the instrument should be greater and longer than usual. I find the best-shaped prostatic catheter to be one, the curve of which is exactly the third of the circumference of a circle five-and-a-half inches in diameter. The eyes should be large and rounded; and I have found it of use to have the lower end of the stylet provided with a piston-plate, so that, by withdrawing this, the mucus may be sucked in through the eyes of the instrument. In some cases, however, a moderately curved gum-elastic catheter, of full size, enters the bladder most easily; in fact, no one curve nor one kind of instrument will answer in all cases. In introducing the catheter, care should be taken when the point enters the prostatic portion of the urethra, to depress the handle well between the thighs, lest the end hitch against the enlarged middle lobe (Fig. 792) or do not sweep sufficiently

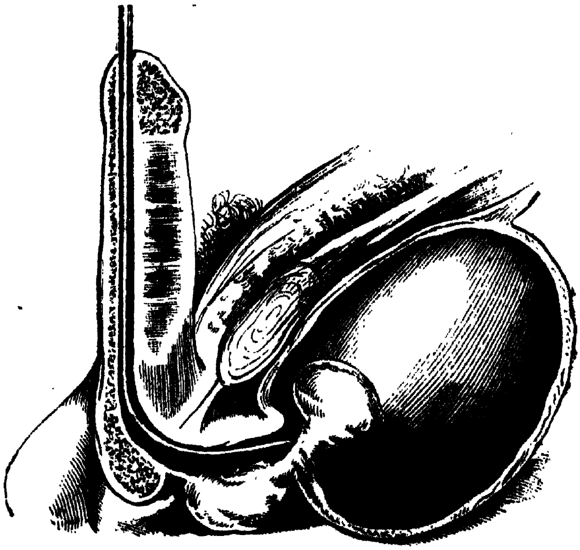


Fig. 792.—Enlarged Middle Lobe of Prostate, arresting progress of the Catheter.

round the pubes. The middle lobe, even when very greatly enlarged and valvular, as was the case in Fig. 790, does not necessarily offer much obstacle to the introduction of the catheter, the point of which pushes it back. It is of great moment to ascertain that the catheter does fairly enter the body of the bladder. In enlarged prostate, the corresponding portion of the urethra is often elongated and dilated, forming a bend or pouch, containing perhaps half an ounce or one ounce of urine; this pouch the catheter may enter and empty, and the Surgeon, then erroneously supposing that he has passed the instrument into the bladder, may rest content; but this is a grievous error, as the bladder is left distended beyond the pouch.

**Treatment of Retention of Urine.**—When retention has occurred, relief can only be afforded by the proper use of the catheter, and this should never be delayed, as typhoid symptoms in elderly people rapidly set in. Three questions present themselves in connection with the treatment of this form of retention.

1. As to the *kind of catheter* that should be used, Brodie recommends a gum-elastic instrument, long, of large size, and kept on a well-curved iron stylet, so to preserve its curve when that is withdrawn. This must be introduced either with or without the stylet; if possible, without it. Other Surgeons of great authority in these matters prefer the silver prostatic catheter; and I certainly think that *for the relief of retention* a silver instrument is safer, and more easily managed, than the gum-elastic one. It might be supposed that a less chance of mischief would result from the gum-elastic than from the metallic catheter, as being the softer and more yielding instrument; but this is erroneous, if the stylet be allowed to remain in, as it is then as rigid at the point, as hard, and as likely to penetrate soft structures as a silver one would be. If the stylet be withdrawn, it is often a very unmanageable instrument; it is impossible to know how to direct its point; and if the obstacle be difficult to surmount, it is not easy to guide the instrument over it. The manœuvre mentioned by Sir B. Brodie will often be of use; viz., after passing the catheter as far as it will go, to withdraw the stylet for three or four inches, and so tilt up the point of the catheter, which then passes over the obstacle.

With the metallic catheter, on the other hand, the Surgeon can feel his way, as it were, and will, if he depress the handle well, as soon as the point enters the prostatic portion of the urethra, find little difficulty in guiding it into the bladder. It is the first introduction of the instrument that especially requires care, and as much gentleness as possible; after it has once been introduced, it will almost invariably readily find its own way.

It is a question whether the patient should be placed in the erect or in the recumbent position, when the catheter is introduced for the relief of urinary retention. I certainly think that the recumbent is not only the easiest position in which to introduce the instrument, but the safest. In old and feeble subjects the sudden withdrawal of the urine, by removing compression from the abdominal veins, and allowing these vessels to refill, may induce syncope, which occurring in the erect position might prove fatal. I have heard of one case, in which the sudden death of the aged patient in such circumstances was attributed to this cause.

By far the most convenient instrument in the majority of cases is the soft

French "elbowed" catheter—the "cathetère à coude," of the size and shape here represented (Fig. 793). The stem is soft and pliable, but the angle and eyed point are made of firm gum-catheter material. By keeping the point well up against the urethra, it will often slip in very easily and smoothly in cases of enlarged prostate.

Fig. 793.—Elbowed Catheter.

A flexible India-rubber catheter is also a useful instrument in the treatment of prostatic retention. Hutchinson states "that in almost all cases of prostatic retention, a flexible India-rubber catheter without a stylet can be passed into the bladder." Its use is so perfectly painless and free from danger, that it may always be tried before adopting more severe measures. If from any cause it be necessary to retain such an instrument, Hutchinson uses a nozzle with rings passed into the orifice of the India-rubber catheter, and fitted with a "styletted plug." The nozzle is about three-quarters of an inch in length, and is fitted accurately by the plug. The stylet reaches about two inches down the catheter so as to stiffen it. With such an instrument in use, the patient need not be confined to bed.

2. The next question in connection with the relief of retention in these cases is, whether the catheter should be *left in the bladder*, or be *withdrawn* after the viscus is emptied. As a general rule, it is certainly far better not to leave the catheter in, for the reasons given at page 854. The instrument should be introduced twice in the twenty-four hours; and care should be taken, if possible, to empty the pouch behind the prostate by depressing its point. When the instrument is used habitually in this way, the gum-catheter may be employed. Should the mucus be very viscid and offensive, the bladder may be washed out with tepid water through a double current catheter. After the bladder has been emptied for the first time, it will be found to refill in the course of a very few hours, usually in six or eight, the secretion of the kidneys appearing to be set free on the removal of the pressure.

Should any great difficulty be experienced in introducing the catheter, it may be thought desirable to leave it in the bladder for two or three days; and then a gum-elastic one is always to be preferred, as in these circumstances it presents a great advantage over the silver catheter, becoming soft, accommodating itself to the shape of the parts after the stylet has been taken out, and not being so liable to irritate the mucous membrane with its point, which, dipping down into the pouch behind the prostate, acts as a syphon, emptying this part of the bladder far better than a silver catheter could do.

3. The third question in connection with the relief of retention from enlarged prostate, is as to the course that should be pursued *if no instrument can be introduced into the bladder* in the ordinary way. In these cases, which, however, very rarely occur, three lines of practice may be adopted; *puncture of the bladder above the pubes, puncture through the rectum,* or *forcible catheterism.*

**Puncture above the Pubes** can very seldom be required. Since the University College Hospital was opened, only three cases have presented themselves in which it was thought proper to adopt such a procedure for retention from enlarged prostate; and in one of these cases, which was under my care, the enlargement of the prostate was complicated with impermeable stricture, which was, indeed, the main cause of the retention. The operation consists either in pushing the trochar at once through the abdominal wall; or else, as in tapping for ascites, making a small incision about half an inch in length through the integuments, exactly in the mesial line, immediately above the pubes, and then passing a curved trochar, with its concavity downwards and backwards, into the bladder behind that bone, and consequently underneath the reflection of the peritoneum (Fig. 794). After the bladder has been emptied, the cannula or an elastic gum tube must be left in for the escape of the urine, whilst the continuity of the natural passage is being restored. When the bladder is greatly distended, in consequence of retention from enlargement of the prostate or any other cause, the peritoneal reflection is carried up with it, and a considerable portion of the anterior wall of the organ uncovered by peritoneum is left above the pubes. In a case of unrelieved retention from stricture, in which the patient died suddenly during the administration of chloroform, and which I had an opportunity of dissecting, I found that the fundus of the bladder reached to five inches above the symphysis pubis, and was only two inches below the umbilicus; that the line of reflection of the peritoneum was $3\frac{1}{8}$ inches above the bone; and that the space uncovered by serous membrane was $2\frac{1}{4}$ inches wide. The bladder contained nearly forty ounces of urine, the retention having lasted during forty-eight hours.

Brander of Jersey and others have modified this operation by puncturing through the symphysis pubis, by means of a trochar and cannula. There is not, however, sufficient evidence to enable us to decide as to the merits of this procedure.

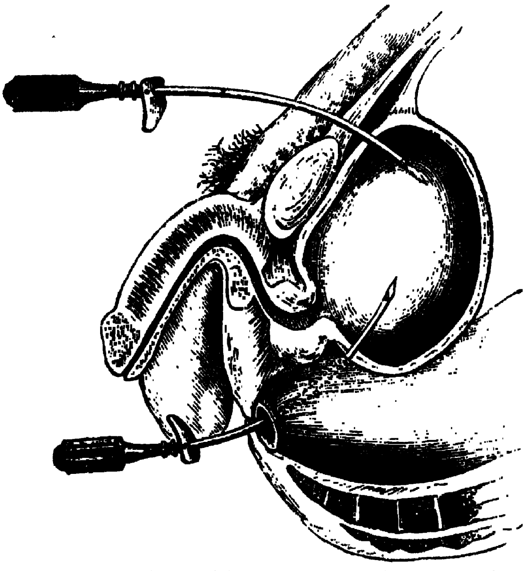


Fig. 794.—Puncture of the Bladder. The upper instrument is in the position of Puncture above the Pubes: the lower in that of the Puncture through the Rectum.

**Puncture through the Rectum** is not generally a safe procedure in retention from enlarged prostate, in consequence of this structure encroaching on that part of the inferior fundus of the bladder which is uncovered by peritoneum. When, however, the retention arises from enlargement of the urethral portion rather than of the lateral lobes, this operation may be safely done; and, indeed, I have known it put in practice with advantage in such cases (Fig. 794).

A procedure that was formerly recommended by Brodie, Liston, and most Surgeons of authority in these matters, was **Forcible Catheterism,** or **Tunnelling the Prostate.** As the retention is generally owing to an enlargement of the urethral portion of the prostate, relief was afforded by pushing the point of a silver catheter through this obstacle into the bladder. A false passage was thus purposely formed, in which the instrument was left for about forty-eight hours, when it would generally enter it again with sufficient readiness on being re-introduced. This practice has, however, been very generally rendered unnecessary by the use of improved instruments, aided by chloroform inhalations; and "tunnelling the prostate" may be looked upon as belonging to a past age of Urinary Surgery, ruder than the present.

After the retention has been relieved, the bladder will often remain in an atonic state for a time, the urine flowing out, but with no power of expulsion, for some weeks. In these circumstances, the catheter should be used twice in the twenty-four hours; good diet, with wine, quinine, and extract of nux vomica may be given, and blisters applied to the sacrum; afterwards, the patient should be taught to pass the catheter for himself once or twice daily.

The radical cure of the impediment to the flow of the urine has been proposed to be effected by removing the enlarged middle lobe of the prostate by ligature, by excision with a lithotrite, or by lateral or median incision of the perinæum. Such operations, however, from their difficulty and danger, should not be lightly undertaken; perhaps the least dangerous mode of removal would be by median urethrotomy.

### OTHER DISEASES OF THE PROSTATE.

**Atrophy of the Prostate** sometimes occurs. It may be the result of exhausting disease, especially phthisis, of old age, of mechanical pressure from tumours or calculi, or of local disease of the gland itself. The atrophy may also be congenial.

**Cancer of the Prostate.**—The prostate is very rarely attacked by cancer, probably more rarely than any other structure in the body. When cancer occurs in this organ, it is usually of the encephaloid and hæmatoid forms. I have, however, seen true scirrhus in the case of a man about 70 years old. He died with secondary deposits in the abdominal gland, and with the liver studded with scirrhous nodules.

Rare as the disease is, I have seen at least three instances of it, and can therefore scarcely agree with the estimate of Tanchou, given by Walshe, that it only occurred five times in upwards of eight thousand fatal cases of cancer.

The *Symptoms* are those of ordinary enlarged prostate. But digital examination *per rectum* will probably detect a large, hard, ill-defined mass entering up into the pelvis and abdomen; and the gradual development of secondary deposits in distant organs will reveal the true nature of this incurable affection.

The only *Treatment* that can be adopted is that calculated to relieve the bladder from the mechanical obstacle to the escape of urine, and to palliate suffering by ordinary means.

**Tubercle of the Prostate** is occasionally, but rarely, met with; and is to be regarded as a manifestation of a constitutional disease. It may lead to extensive suppuration in the ischio-rectal fossa, and possibly to some forms of fistula in ano. Cheesy masses are occasionally found in the prostate in cases of tubercular disease of the epididymis, vesiculæ seminales, and vas deferens. In a case which occurred lately in University College Hospital, in which the patient died of tubercular meningitis after castration for tubercular testicle, two cavities surrounded by cheesy matter, and large enough to admit the top of the thumb, were found in the prostate gland.

**Cysts or Cavities** are sometimes found in the prostate; they may be dilatations of gland-follicles, abscesses, or cavities containing concretions or calculi.

**Prostatic Calculi** have been already described in the Chapter on Urinary Calculus (Vol. II. p. 833).

**Prostatorrhœa** has been described by Gross as a discharge of clear glairy mucus from the prostate, in consequence of irritation of that organ. The disease is characterised by the discharge of a few drops of ropy, viscid mucus from the urethra after micturition or defecation. It is chiefly of importance from its liability to be confounded with spermatorrhœa, and from the depressing effect consequently produced upon the patient's mind.

The *Diagnosis* of prostatorrhœa from *spermatorrhœa* may be effected by microscopical examination of the characters of the discharge.

The *Treatment* consists in attention to the state of the general health; the administration of tonics, more especially of iron and nux vomica; the removal of any local source of irritation in the urethra, rectum, or anus, as stricture, piles, or fissure; and the local application to the prostatic portion of the urethra of the nitrate of silver. The application of a blister to the perinæum is beneficial in some cases.

# CHAPTER LXXII.

## DISEASES OF THE URETHRA.

### URETHRITIS.

**Simple Inflammation of the Urethra** is especially apt to occur in strumous, rheumatic, or gouty individuals, from slight sources of irritation, either direct or sympathetic, that would not excite it in more healthy constitutions. In strumous children, it may arise from worms in the intestines, or from gastric irritation; and in gouty or rheumatic subjects, it appears often to occur in connection with an acid or loaded state of the urine. In other cases, the irritation of a stricture, the passage of instruments, or ordinary sexual intercourse, may occasion the disease, without there being anything of a specific or venereal character about it. Contact with women who are out of health, pregnant, or suffering from leucorrhœa, may and often does give rise to local irritation of this kind. Urethritis, especially when arising from sexual intercourse, is frequently mistaken for gonorrhœa; but from this it may be distinguished by the less intense degree of inflammation, and by the absence of the secondary consequences that frequently follow true gonorrhœa; yet, in many instances, the diagnosis is extremely difficult, especially from the subacute forms of gonorrhœa that are common in London.

*Symptoms.*—Urethritis is characterised by heat, pricking, and tension about the urethra for a day or two, followed by muco-purulent discharge, often rather profuse, and accompanied by some ardor urinæ. The symptoms altogether are not severe, and the disease usually subsides at the end of a week or ten days; but sometimes it becomes chronic, especially if conjoined with stricture, and then constitutes an extremely troublesome affection, more particularly in gouty individuals.

*Treatment.*—The treatment of urethritis is mildly antiphlogistic. The bowels should be kept open, and salines freely administered; in many cases small doses of colchicum, in combination with alkalies, will be found of especial service in cutting the disease short. The use of emollient or slightly astringent injections, such as opiate lotions, or a very weak solution of acetate of lead, with belladonna, will be found serviceable as the disease is on the decline, but not until then; and when the affection has reached a chronic stage, small doses of copaiba may be advantageously administered. The diet in all cases should be of the blandest character, stimulants of all kinds being interdicted.

If the disease be conjoined with slight stricture, it may not unfrequently give rise to temporary retention of urine. This may, however, most commonly be readily relieved by antiphlogistic treatment, cupping or leeches to the perinæum, the warm hip-bath, and salines, with, perhaps, opiate suppositories, and plenty of demulcent drinks. The catheter should not be used in these cases, if it be possible to give relief without it.

**Urethral Abscess** occasionally forms as the result of urethritis, a soft fluctuating point being perceived in the neighbourhood of the canal. As soon as this is detected, it should be opened, when the aperture that results will readily close. If left, it will probably not burst externally, but into the urethra, the tissues in this direction being less resistant; and then, if it should be opened externally as well, a troublesome urinary fistula will result.

**Perineal Abscess** may form as the result of stricture or of urethritis, in whatever way excited; the patient complaining of a sensation of weight, with pain and throbbing, deep in the perinæum. On examination, a hard tense swelling will be found, situated a little anteriorly to the anus, and extending along the side of the urethra. It presents no sign of fluctuation until it comes forwards into the scrotum.

The *Treatment* consists in the application of leeches, followed by fomentations, and an early incision through the perinæum into the swelling. In some cases, the abscess is situated altogether externally to the urethra, and then the aperture closes readily enough, like that of any other ordinary abscess. In other cases, it communicates with the canal, and then fistulous openings are left, through which a certain quantity of urine escapes. These apertures gradually tend to close if they be not complicated with stricture or other urethral disease; should they be so, they will require special treatment, of a kind that will be hereafter described.

## GONORRHŒA.

**Gonorrhœa** is a specific disease, accompanied by inflammation and an abundant muco-purulent discharge; affecting the urethra most commonly, but also the other mucous membranes of the genital organs, as of the prepuce and the glans in the male, and of the vulva and vagina in the female.

The urethra is the usual seat of gonorrhœa in the male; and the disease may be looked on as an infectious urethritis. It is usually fixed with greatest intensity in the fossa navicularis; but it may extend itself over a much greater surface, affecting the entire length of the canal, and even the whole mucous lining of the bladder. In the female it commonly spreads over the extensive mucous surface of the internal organs of generation, and sometimes invades the uterus and Fallopian tubes.

CAUSE.—Gonorrhœa has its origin in the female, and is constantly developed *de novo* in prostitutes, that is, without infection from the male. It is a highly infective inflammation of the mucous membrane of the vagina generated by the decomposition of retained semen and of foul discharges, the result of repeated acts of indiscriminate intercourse without proper attention to cleanliness. It is impossible to say where urethritis or vaginitis ends, and infective gonorrhœa begins. In the male, gonorrhœa arises in all cases from the application of a peculiar animal poison, generated in the female by impure or indiscriminate sexual intercourse, to the parts which it attacks, and must not be confounded with the various non-specific inflammatory diseases that may affect the parts commonly the seat of gonorrhœa, and which are all characterised by muco-purulent discharges.

The poison of gonorrhœa differs entirely from those of the venereal diseases described in Chapter XXXVI., as has been fully proved by the unerring test of inoculation; these diseases not being capable of reproducing one another in any circumstances.

The inflammatory suppuration which is characteristic of gonorrhœa has these peculiarities: 1. It has a distinct and lengthened period of incubation; 2. It rapidly propagates itself by continuity of tissue along the mucous tracts that it affects; 3. It is contagious in the highest degree not only when the pus is applied to, and, as it were, rubbed into the mucous surfaces of the generative organs during coitus, but when it simply touches other mucous surfaces; and 4. It is attended by remote constitutional phenomena partaking of a pyæmic character.

CHARACTER.—Gonorrhœa is usually looked upon as a purely local affection of the genital organs. Some Surgeons, however, amongst whom may be especially mentioned Travers, seem to consider it as occasionally assuming a constitutional character; in this opinion I entirely agree. Although gonorrhœa in the early stages is doubtless a strictly local affection, yet it is occasionally followed by a particular train of very characteristic phenomena, that can scarcely be looked upon in any other light than as the result of constitutional infection; the more so, as some individuals never have gonorrhœa without the disease being followed by these sequences, whilst others are altogether exempt from them. The parts that are secondarily affected are chiefly the fibrous tissues, the mucous and the cutaneous surfaces. The affections of the *fibrous tissues* give rise to, so-called rheumatism and to peculiar forms of inflammation of the testicle and of the sclerotic. The affection of the *mucous membranes* displays itself in specific inflammations of the throat, and of the eyes; and the *skin* becomes the seat of certain eruptions. The occurrence of these various affections, assuming as they do a specific type so distinctly marked that they can at once be characterised as gonorrhœal, certainly tends to show that the disease impresses the constitution in some peculiar manner, somewhat analogous to syphilis and pyæmia; though in a far minor degree, and with much less certainty, than these diseases.

SYMPTOMS.—The symptoms of gonorrhœa in the male may be divided into three stages:—1. The Incubative Stage, or the period of Irritation; 2. The Acute Inflammatory Stage; and, 3. The Chronic Stage.

1. **Incubative Stage.**—The first stage, that of irritation, usually comes on from three to five days after connection, when the patient begins to experience some degree of heat, itching, and general irritation about the penis. The lips of the urethra are somewhat red and swollen; its orifice gapes; and, on squeezing it, some mucus exudes. This stage usually continues for three or four days, but sometimes longer, for six or eight, when it terminates in the second stage, which is one of active inflammation.

2. **Acute or Inflammatory Stage.**—The discharge now becomes abundant, thick, and of a greenish-yellow-colour; there is great pain in passing urine, with considerable heat and smarting, and the urine, which flows in a diminished stream, is passed with increased frequency. The urethra is swollen,

firm, and cord-like to the touch; the whole penis, indeed, looks generally red and turgescent. As the disease advances, and the bulbous portion of the urethra becomes affected, weight and tension in the perinæum will be complained of. If the prostatic portion be the seat of disease, there will be heat and weight about the anus. During the whole of this period there is generally a good deal of constitutional disturbance, restlessness, and fever.

One of the most troublesome symptoms in this stage of the complaint is the occurrence of **Chordee**, which consists in painful erections at night, with a twist in the body of the penis, which is usually curved down towards the scrotum.

3. **Chronic Stage.**—These symptoms usually continue for about a fortnight, when the third stage, that of subacute or chronic inflammation, sets in. During this period of the affection the inflammatory symptoms gradually subside, but a thin muco-purulent discharge keeps up, with some degree of heat and irritation about the urethra, and occasional smarting in passing urine. Under proper treatment, this usually subsides in the course of another fortnight or three weeks; but, if neglected, or in certain constitutions, it may last for many months, or even years, then degenerating into a *Gleet*. In proportion to the continuance of the affection the inflammatory symptoms subside, though the specific and contagious character does not disappear, and the affection may continue so long as the discharge keeps up. Hunter mentions the case of a girl who had been two years in the Magdalen Hospital, and who infected a person with whom she had connection immediately after she left that Institution. The persistence of the contagion of gleet is, it is true, more marked in women than in men. So long, however, as any purulent discharge continues from the male urethra, though it be but a daily drop, the patient must be looked upon as infectious.

The severity and the continuance of gonorrhœa are often opposed to one another. Thus the disease is most severe in young and plethoric persons, and in first attacks; but it is most difficult of cure in strumous and phlegmatic constitutions, more especially if there be a gouty or rheumatic tendency co-existing, and is very troublesome to remove after repeated attacks. I have observed repeatedly that it is very apt to degenerate into a gleet in people who are subject to chronic eczema.

There is a form of chronic gleet which continues very persistently after an attack of gonorrhœal epididymitis. In these cases the discharge is not so much urethral as testicular. It appears to proceed from the increased exudation from the mucous membrane of the secretory and efferent structures of the testis, during the process of resolution of the inflammation.

The length of time that the infection of gleet will continue in both sexes, but especially in the female, makes it somewhat difficult to say whether the poison of gonorrhœa can be generated *de novo*, as it is not improbable that many individuals communicate the disease, believing themselves to be perfectly cured, though still suffering from slight gleet.

**Gleet.**—The term *gleet* is applied to any mucous or muco-purulent discharge, which is very small in amount and persists for an indefinite time unaccompanied by any other obvious symptoms. This condition is one which gives rise to great mental uneasiness in many patients, and some varieties are, moreover, liable to terminate in stricture if unrelieved. The correct diagnosis of its nature and source is, therefore, of extreme importance. In the first place, it is necessary to remember that in young men a somewhat copious flow of mucus is apt to accompany an erection of the penis. When, as is frequently the case, an erection occurs just before waking in the morning, the mucus may be found glueing the lips of the urethra together, and may be mistaken by the patient for a gleet. Again, true gonorrhœal gleet must not be confounded with prostatorrhœa (see p. 870). Desormeaux has shown by means of the endoscope, that a true gonorrhœal gleet is due to the presence of chronically inflamed patches of mucous membrane in the urethra. These patches are purplish or dark red in colour, whereas the normal urethra is a pale pink. Sometimes the surface of the mucous membrane is covered with small granulations, like those seen on the conjunctiva in granular lids. This condition Desormeaux calls "granular urethritis." The patches may be multiple, but more often there is only one situated in the bulbous portion of the urethra. The *symptoms* of such a condition are the following. A slight, sometimes almost colourless sometimes yellowish, discharge will be found glueing the lips of the urethra together in the morning. This discharge is little affected by diet or stimulants, but is usually greatly aggravated by connection. If during micturition the first few drops of urine be passed into a separate vessel, flocculi of mucus and pus are seen floating in it. There is no pain or discomfort in micturition, but the stream may be slightly narrowed, and a few drops of urine may be retained in the urethra, and dribble away afterwards, as in a slight stricture. These inflamed patches may usually be detected without difficulty by the use of the olive-headed bougie. As the sound passes the inflamed spot, the patient will complain of pain, and on withdrawing it a drop of blood may be found upon its bulb. A slight feeling of resistance to the instrument is also felt.

TREATMENT.—The treatment of gonorrhœa must be conducted with reference to the stage to which the disease has attained, but especially with regard to the amount of inflammatory action accompanying it. It is of two kinds, *rational*, and *specific* or *empirical*. Both plans are useful, and, indeed, usually necessary for a proper cure, but they cannot be adopted indiscriminately. Thus, if specific means be employed during the acute inflammatory stage of the complaint, much mischief may ensue; whilst, if antiphlogistic treatment be persevered in for too long a time, the disease may be kept up indefinitely.

It has been proposed to adopt what has been termed the *abortive* or *revulsive* treatment, during the earliest stages of gonorrhœa ; indeed, during the *incubative* period. This method consists either in the injection of a very strong solution of the nitrate of silver into the urethra, or in the application to the inflamed mucous membrane of a strong ointment of that salt by means of a bougie smeared with it ; other Surgeons, again, have recommended the administration of very large doses of copaiba at this period. These various plans have, however, deservedly fallen into disrepute. I have on several occasions seen most intense inflammation produced by this mode of treatment, and never, in any case, any good result. Independently of this, it is impossible to know whether the case, in the earliest stage, will prove to be one of simple urethritis or a specific gonorrhœa.

In the *acute inflammatory stage*, attended by heat, swelling of the organ, great ardor urinæ, and abundant muco-purulent discharge, the treatment must be entirely antiphlogistic, the activity of the measures being proportioned to the intensity of the inflammation. If this be very severe, leeches may be applied to the perinæum, or to any very tender point along the urethra. If it be not so intense, warm hip-baths, poppy fomentations, or the envelopment of the penis in warm-water dressing, will be of essential service. At the same time the urine must be diluted, and its acidity lessened, by the patient drinking large quantities of alkaline diluents—barley-water or linseed-tea containing a little nitre or carbonate of potash in solution, or soda-water; and the skin and bowels may be kept in action by the administration, every second night of a dose of blue pill, and every fourth or sixth hour, of a powder composed of a drachm of sulphate of magnesia, 5 grains of nitre, and $\frac{1}{12}$th of a grain of tartar emetic, dissolved in a wine-glass of water. All stimulants must be avoided, the diet being restricted to light slops, and perfect rest enjoined. By such means as these, the activity of the inflammation will be gradually lessened, the discharge becoming thinner, and smarting in micturition less severe, and the erections less painful. The patient should also be desired to pass his urine frequently, so that it may not be too concentrated.

When the *third stage* of the disease has been reached, specific treatment may be employed with great advantage; while, if recourse were had to it at an earlier period, it would certainly increase the inflammatory action and give the patient much distress. Even in this stage the specific remedies, such as copaiba and cubebs, must be cautiously given; the Surgeon feeling his way with them, and being prepared to discontinue them and to return to strictly antiphlogistic measures, if he find that they increase the irritation. Should the disease, however, from the commencement, have assumed a subacute character, the specific treatment may with safety be adopted at a much earlier period.

Copaiba and cubebs are the remedies that are almost universally used in this stage of gonorrhœa. Of these, copaiba is the least irritating, and consequently most generally to be preferred. It may be administered in a variety of ways; in capsule, pill, draught, or extract. The capsule is generally to be preferred, on acount of the nauseous taste being thus more readily disguised; but in many cases it acts with more certainty, and with better effect, if given in either of the other forms. When the capsules are given, the patient may take from six to eight or ten in the day, and should at the same time have an alkaline mixture, which increases materially the effect of the drug. A very excellent mode of administering copaiba is to rub it down into a mass with burnt magnesia, and to let the patient take about a drachm of this paste three times a day, in a bolus wrapped in wafer-paper; or, if the taste be not much objected to, he may take it most advantageously in mucilage, with liquor potassæ and tincture of henbane.

In some relaxed constitutions, and more particularly after frequent claps, cubebs will be found to cure the patient more readily than copaiba, or rather most successfully if given in combination with it. An excellent plan is to put about half an ounce of powdered cubebs into a mortar, and to rub it up with as much copaiba as will form a stiff paste, of which the patient should take a drachm as a bolus thrice daily. The effects of this electuary are often most striking; but it can only be used in the constitutions indicated, and after the more active inflammatory symptoms have subsided.

It is during the third stage of gonorrhœa that **Injections** may advantageously be used. Much and very unfounded prejudice exists against their use in the minds of many; but surely it is as safe to apply proper local applications to an inflamed urethra as it is to an inflamed conjunctiva; and the bad consequences, such as stricture and inflamed testicle, which have sometimes been referred to their use, have either been due rather to the long continuance and to the severity of the disease itself than to the remedies employed, or to their application at too early a stage or of too great a strength. It is in long-standing cases of gonorrhœa, in which the discharge continues for months or years, that stricture results, not in cases of ordinary duration; and in these it is the result of the chronic inflammatory thickening of the mucous membrane, and has no more to do with the injections than with the copaiba or salines which the patient may have taken. As the ardor urinæ subsides, emollient and slightly astringent injections may be used. The best is perhaps the acetate of lead in tepid water, of the strength of two grains to the ounce. If this induce irritation, a few grains of the watery extract of opium may advantageously be added. As the disease subsides, a stronger astringent is required, and then one or two grains of the acetate of zinc may be added to each ounce of the injection; or a very weak solution of sulphate or chloride of zinc may be employed, gr. ij of the first, and gr. j of the second, to each ounce of water; or an injection of gr. $\frac{1}{4}$ of the nitrate of silver to the ounce may be used. During the whole of this stage, the diet and habits of life must be carefully regulated, and all stimulants interdicted. The injections should be discontinued as soon as the discharge has ceased; unless this be done, they may re-induce it.

The mode of injection is of importance. A glass syringe should always be used, with a smooth rounded nozzle. The patient sitting on the edge of the chair and holding up the penis, should carefully insert the end of the syringe between the lips of the urethra, and then slowly throw in the injection as far as it will go. Although the inflammation is usually confined to the anterior portion of the urethra, yet it may extend to the bulb, and the injection should be applied to the whole length of the inflamed mucous membrane. If any enter the bladder it cannot signify, as it will immediately be decomposed by the salts and mucus of the urine.

Instead of the ordinary glass syringe, the injector (Fig. 795) may be advantageously used. This injection is thrown from behind forwards, so that when passed beyond the inflamed part it washes out the discharge, instead of forcing it further on.

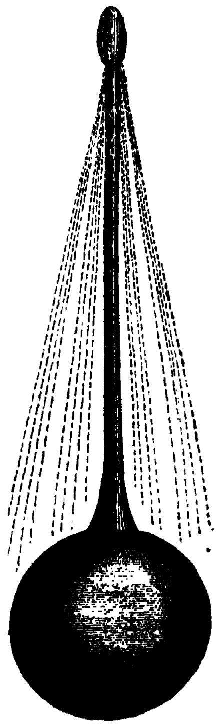


Fig. 7
Injector.

**Treatment of Gleet.**—In **gleet**, much difficulty will often be experienced in curing the patient of his discharge. Here much depends not only on the administration of proper remedies, but in care being taken attentively to regulate his habits of life. It will constantly be found that, after the disease has apparently been cured, excesses at table, and more especially the drinking of beer, or of effervescing or acid wines, will bring back the discharge. It will also return after connection, though it have previously ceased entirely. This is especially the case in strumous, gouty, or rheumatic constitutions, in which all urethral inflammations are with difficulty removed. In these cases, then, abstinence from alcoholic liquids and dietetic stimulants, and a continent life must be strictly enjoined ; but the local treatment requires careful attention.

The conditions of the urethral mucous membrane has already been fully described. This condition is difficult of cure ; for, as Desormeaux has pointed out, no injection, which the healthy portion of the urethra is capable of bearing, will have much effect upon the inflamed patch. He therefore recommends the application of a very strong solution of nitrate of silver through the endoscope ; but equally satisfactory results may be obtained by the use of Guyon's injector (Fig. 796). This consists of a hollow bulbous sound perforated in the bulb, and fitted with a small syringe. The bulbous sound having been passed first up and down the urethra till the exact situation of the inflamed spot is found by the tenderness and slight cling before mentioned, the perforated head is held fixed at the diseased spot, and a few drops of a solution of nitrate of silver (ten to twenty grains to the ounce of water) are injected. The patient should pass urine immediately before the injection, and not again for some hours if possible. Berkeley Hill, who has had great experience of this mode of treatment, states that, if the patient keep quiet for some time after, no complications are likely to follow ; but neglect of these precautions may be followed by swelled testicle or even perineal abscess. After the operation, a weak astringent injection must be used for a few days, and the passage of bougies for a short time after is usually necessary to complete the cure. Otis, of New York, is of opinion that every prolonged gleet is the result of a narrowing of the canal, and he recommends internal urethrotomy as a cure—cutting the urethra up to its normal size by the method described under the treatment of stricture of the urethra. The operation is somewhat severe, and should never be had resort to till milder means have failed.

Fig. 796.—Guyon's Injector. The Smaller Figure represents the Nozzle.

The treatment of gleet may therefore be summed up as follows. The patient must be carefully examined, in order to detect if possible some constitutional condition, such as struma, gout, or rheumatism, which may serve as a guide as to general treatment, diet, and use of stimulants. Change of air and sea-bathing are often of essential service. At the same time, the electuary of cubebs and copaiba, or one composed of cubebs and the sesquioxide of iron, may be administered with advantage, and the injections recommended for the chronic stage of gonorrhœa may be persevered with. Should these fail, and should the olive-headed sound give distinct evidence of a tender spot, and perhaps a slight narrowing of the urethra, the passage of a full sized metallic bougie every second or third day should be tried. If, after a fair trial, this fail also, injection of nitrate of silver by Guyon's injector must next be had recourse to, followed by mild injections and the passage of bougies ; and, lastly, if everything else have failed, and a distinct narrowing of the canal be present, internal urethrotomy may be tried as a last resource.

Complications of Gonorrhœa.—Gonorrhœa, when acute or virulent, seldom runs its course without local complications of some kind, the result of the propagation of the inflammation to neighbouring parts, often of considerable severity, and occasionally even hazardous to life ;—such as chordee, phimosis, sympathetic bubo, perineal abscess, irritability of the bladder, retention of urine, hæmorrhage from the urethra, &c. Many of these complications present no special features, but require to be treated on general principles, without reference to their specific cause. Others demand more special management, and these we may briefly consider here.

**Inflammation of the Lymphatics of the Frænum** may occur, stretching along the sides and dorsum of the penis in the form of hard thread-like lines, with much redness and œdema of the integuments, and general swelling of the organ, the glans in these cases often assuming a turgid aspect and a dull brick-red colour.

This condition is a very serious one, as it may lead to one of two consequences, or both may ensue, viz., inflammation and suppuration of the inguinal glands, or blood-poisoning. It is the latter result that gives rise to the most serious constitutional effects in gonorrhœa, closely resembling the less severe forms of pyæmia, viz., the so-called gonorrhœal rheumatism, and abscess in or around the prostate.

**Chordee**, or painful erection of the penis, with twist of the organ, coming on at night, is often a most distressing and troublesome symptom. It is usually best relieved by the application of cold to the part, but more especially by the administration at bed-time of a pill composed of gr. j of opium with gr. v of camphor, the camphor acting as a direct sedative to the generative organs. Ricord recommends a suppository of camphor and opium, gr. x of camphor, and gr. j of the watery extract of opium, to be introduced into the rectum an hour before bed-time, as the best means of removing the tendency to chordee.

**Irritability of the Bladder with Spasm of its Neck, Strangury, and Dysuria,** may be of two kinds ; either *inflammatory*, coming on in the earlier stages of the disease with pain in the perinæum, and all the symptoms of active inflammation about the part strongly marked ; or *atonic*, supervening at a more advanced period, without any special signs of inflammation. In the first case, leeches to the perinæum, hot poppy fomentations, the warm bidet, with full doses of Dover's powder, or of henbane and carbonate of potash or nitre, will afford much relief. When the disease is *atonic*, the administration of tincture of perchloride of iron, conjoined with local soothing remedies, as the poppy fomentations or bidet, and an opiate or belladonna suppository, will be beneficial.

**Cystitis**, of an acute character, may occur either by the metastasis or the extension of the urethral inflammation. When there is metastasis the urethral discharge diminishes or either ceases, just as in epididymitis; the patient is seized with intolerable and frequent dysuria, strangury, and general febrile disturbance. The urine becomes loaded with muco-pus. The condition is perilous. There is danger to life if the constitution be broken, and there is always danger of prolonged or possibly intractable subacute cystitis.

The *Treatment* of this condition consists in the employment of belladonna or opiate suppositories; the frequent use of warm hip-baths; the application of fomentations to the perinæum, and of hot poultices to the pubic region. Brodie makes the important practical statement that, if the urine continue acid, the best treatment consists in the administration of calomel and opium. This is entirely in accordance with my experience, and where the patient is moderately young, and the urine acid, with pulse good, calomel with opium, or Dover's powder, will give effectual relief. As the cystitis subsides, the urethral discharg ere-appears.

**Retention of Urine from Gonorrhœa** may set in at any period of the acute stage. The obstruction is usually dependent on congestion and inflammation of the mucous membrane of the urethra. Leeches to the perinæum, the warm hip-bath, and opiate suppositories, will probably afford relief. It is always desirable to avoid using the catheter, as it is apt to lacerate the swollen and softened mucous membrane, and thus to occasion troublesome bleeding; and will always produce much pain, and increased irritation of the canal. Should, however, the retention have continued twenty-four hours, or longer, it will probably not give way to the means above indicated, and then it will be necessary to use the instrument, when a full-sized silver one should be very carefully introduced; a large instrument entering the bladder as easily as a smaller one, and with less risk of injury to the tender walls of the canal.

When the catheter has been introduced, it is often somewhat difficult to determine whether it should be left in or taken out. If it be left in, inflammatory action is increased. If it be taken out, the Surgeon may not be able easily to introduce it again. The solution to this question is to be found in the facility with which the instrument is passed. If it have been introduced without much difficulty, it is better to withdraw it after the bladder has been emptied, and to continue the antiphlogistic treatment, when a second introduction may not be required. If, on the other hand, the catheter have been passed with great difficulty, and be firmly grasped either by spasm or stricture, it should be left in; but very active treatment must be employed to prevent it from exciting too much inflammation.

It must, however, be remembered that the retention may be due to more serious conditions; to prostatitis, to abscess in the prostate or the perinæum, or to inflammatory exudation in the tissues about the neck of the bladder. In these circumstances, more active antiphlogistic measures will be required, with the use of the catheter twice in the twenty-four hours, and probably free incisions into the perinæum, if there be pus or urine extravasated into that region.

In many cases of gonorrhœal retention, an old stricture complicates the clap. Here the employment of energetic antiphlogistic measures and the use of the catheter are indicated ; but, as the stricture is the chief cause of obstruction, the treatment must be directed to it.

**Hæmorrhage from the Urethra** may occur either as the result of chordee, and consequent rupture of some blood-vessels of the corpus spongiosum, as the consequence of attempts at passing the catheter, or as a kind of exudation from the mucous membrane. Most commonly it may be arrested by the application of ice, and the employment of moderate local antiphlogistic treatment. Should it be abundant, the introduction of a large gum-elastic catheter, and pressure by means of a bandage to the penis or perinæum, will arrest it.

SEQUENCES OF GONORRHŒA.—The sequences, or more remote complications of gonorrhœa, are partly local and partly constitutional. Amongst the local we find more particularly **Warts** about the prepuce and glans or within the urethral orifice, which require to be treated by excision or caustics ; and **Stricture**, the management of which is fully described elsewhere. In some cases, also, in consequence of extravasation of blood, or the effusion of plastic matter into the corpus spongiosum or the corpora cavernosa, limited and localised **Induration and Thickening of the Penis** may result, attended by chordee, painful erections, and a permanent twist in the organ. In such conditions as these, an attempt may be made to produce absorption of the effused mass, by the administration of small doses of bichloride of mercury, with the inunction of iodide of lead ointment.

After the cure of a clap that has been of long continuance, the generative organs are often left in a *weak and irritable state ;* the penis, scrotum, and spermatic cords being lax and elongated, with an apparent want of power, and often painful and dragging sensations about the cords and groins.

Besides the strictly local complications of gonorrhœa, certain sequences, to which some constitutions are especially liable, occasionally occur as the result of this disease ; viz., inflammation of the testes and of the eyes, rheumatism, cutaneous eruptions, and sore throat. Some of these, as the affections of the eyes and testes, may be either local or constitutional ; the others are clearly constitutional. The constitutional effects of gonorrhœa offer characters that have some analogy to those presented by the more chronic and subacute forms of pyæmia. This is more especially the case in monarthritic inflammation of the knee or wrist, leading to disorganisation or permanent ankylosis of these joints.

**Gonorrhœal Epididymitis** is certainly the most common of these sequences. It most invariably affects only one testis, and commences in the epididymis, whence it extends to the body of the organ. It usually occurs in individuals who have a lax and long scrotum, with very pendulous testes. It seldom sets in before the third week after the occurrence of gonorrhœa, but may occur at any period during the continuance of the discharge, though it is more frequent between the fifth and sixth weeks than at any other time. In cases of gleet, also, it not uncommonly occurs at a later period. In many instances it is referred to some slight injury—a blow, or squeeze, received during the continuance of the gonorrhœa ; but in some cases it would appear to arise from extension of the inflammation along the ejaculatory duct ; and in others from a kind of metastasis of the morbid action from the urethra to the testis. That the disease commences in the epididymis, may be advanced in support of the first opinion; whilst the fact that the discharge usually ceases when the inflammation of the testicle comes on, and returns as it subsides, may be adduced in support of the doctrine of its metastatic origin. Curling is of opinion that the diminution of discharge is due to counter-irritation, as he has seen a case in which the urethral discharge ceased, although the orchitis had been occasioned by a blow. As the symptoms and treatment of gonorrhœal inflammation of the testicle present nothing peculiar, I shall reserve their consideration until we speak of diseases of this organ. Gonorrhœal epididymitis is apt to be followed by long-continued gleet, consequent on the exudation from the lining membranes of the inflamed vas deferens, and the secretory apparatus of the testes.

**Gonorrhœal Inflammation of the Eyes** is fortunately not of very common occurrence. It may affect either the conjunctiva or the sclerotica.

**Gonorrhœal Conjunctivitis** is one of the most destructive forms of ophthalmia, giving rise not unfrequently, in the course of forty-eight hours, to the most intense chemosis, with opacity and softening of the cornea, followed by staphyloma and a discharge of the humours. In the majority of instances only one eye is affected; but, in some, both are involved to an equal extent. The disease commences with the ordinary symptoms of conjunctival inflammation; itching and swelling of the eyelids, velvety redness of the conjunctiva, muco-purulent discharge, with much lachrymation. The chemosis sets in early, and is very severe; and, unless treatment afford speedy relief, the consequences are most disastrous to vision. Lawrence states that, of 14 cases that fell under his observation, 9 had only one eye affected and 5 both. Of the nine in whom one eye only was diseased, the organ was lost in 6 cases; of the 5 in whom both eyes were affected, both organs were destroyed in one case; in 2 one eye only was lost; one patient recovered imperfectly; and in only one did complete recovery ensue.

It has been a question with Surgeons, whether gonorrhœal ophthalmia is the result of the direct application of the specific pus to the conjunctiva, or occurs as a constitutional disorder. There can be little doubt that the application of the pus to the surface of the conjunctiva will occasion the disease, but at the same time it is perfectly certain that in many instances there is no evidence of contact, the inflammation occurring in both eyes without the patient having apparently communicated it; and, though it is necessarily difficult to adduce positive proof on this point, it is but reasonable to presume that such cases may be constitutional.

The *Treatment* of this dangerous affection must be of an active character; blood should be taken freely from the temples by cupping, or, if the patient be sufficiently robust, from the arm, as strongly recommended by Lawrence, who placed great reliance on it; he must of course be kept in a dark room, and on strict antiphlogistic regimen. The disease must, however, be met, and the eye can alone be saved, by active local treatment. The most active topical agent that we possess is the nitrate of silver. The use of this astringent, originally introduced by Little, has been much insisted on by Guthrie, Walker, and others, and is generally adopted at the present day, being certainly the most useful agent that we possess. Surgeons differ somewhat in opinion as to the strength of the application; some, the Germans especially, advise that the solid stick should be used; whilst others employ it in solution, of the strength of a drachm to the ounce of distilled water. Wharton Jones employs a weaker solution, one of four or five grains to the ounce, and I have seen cases very successfully treated by this plan; so much so, indeed, that I am disposed to prefer it to the stronger solution. A few drops must be introduced about twice in the twenty-four hours, into the inner canthus of the eye; the lids in the meantime being kept covered by compresses dipped in weak alum lotion, and the purulent discharge, as it accumulates, carefully washed away by tepid alum injections. In doing this, great care must be taken that none of the discharge come into contact with the eyes of the Surgeon or nurses, as it is highly contagious, and will almost to a certainty produce the disease; instances are recorded in which, in this way, the attendant's vision has been destroyed. If the chemosis be considerable, it must be incised; and, as the inflammation subsides, belladonna lotions may be employed with advantage, and the use of the nitrate of silver gradually discontinued.

**Gonorrhœal Sclerotitis** is by no means of such frequent occurrence as the conjunctival inflammation; when it happens, it will commonly be found to be associated with gonorrhœal rheumatism, and not unfrequently with inflammation of the testicle, occurring apparently in individuals in whom there is a tendency to affection of the fibrous tissues. This disease is evidently of constitutional origin, as it cannot possibly arise from local contagion; it is attended by the ordinary signs of sclerotic inflammation, and is usually accompanied by some degree of iritis.

In the *Treatment* there is nothing very peculiar. Cupping or leeches to the temples, with belladonna fomentations, are the principal local means; and calomel and opium, continued until the gums are affected, constitute the chief internal remedies; these means must be persevered in until the anterior chamber clears, and any effused lymph is absorbed. As the disease declines, and especially if the patient be somewhat debilitated, soda, rhubarb, and bark in powder may be given internally, and blisters kept open on the temples.

**Inflammation of the Nose,** attended by profuse suppuration, is a complication that I have more than once had occasion to observe in gonorrhœa. The swelling of the organ is considerable, the tenderness great, and the discharge abundant; a condition, indeed, of the Schneiderian membrane that seems analogous to the inflammation of the conjunctiva just described.

The *Treatment* that I have found to succeed best, consists in fomentations followed by astringent lotions or injections.

**Gonorrhœal Rheumatism** principally occurs in young and otherwise healthy persons. It is of two kinds; in one, the most common, and indeed, the typical variety, the fibrous and muscular structures are affected; in the other the joints are implicated. It is a disease that appears to be closely associated with some forms of blood-poisoning—possibly in some cases with pyæmia. It is of two kinds, the fibroid or plastic, and the suppurative. The fibroid is intimately associated with those forms of blood-disease in which fibrinous exudations are formed in internal organs, more especially on the serous surfaces, as the pleura, the peri-, and the endocardium. The fibroid or plastic form of gonorrhœal rheumatism is not unfrequently accompanied by inflammation of the testicle or of the sclerotic. It commonly affects the fleshy parts of the body, as the hips, the shoulders, and the thighs, and not unfrequently occurs in the soles of the feet. It is always very painful at night, but is not commonly attended by any very severe constitutional disturbance. The suppurative, more rare, appears in truth to be a variety of pyæmia, directly due to self-infection of the patient from pus retained in the deeper portions of the urethra or contaminating the system through the medium of the lymphatics. In these cases, the inflammation, when it affects a large joint, is always monarthritic. The knee is the one that specially suffers, permanent ankylosis consequent on destruction of cartilage resulting. The synovial form presents the ordinary characters of severe and often destructive inflammation of the joint, the knee or ankle being chiefly involved. Ankylosis is the chief danger to be apprehended as a remote result of gonorrhœal arthritis, and it is mostly incurable.

*Treatment.*—In the plastic form small doses of calomel and opium, followed by iodide of potassium, should be steadily given. In the more truly arthritic form of the disease, mercurials are not so much needed, and the chief reliance should be on the iodide of potassium with alkaline tonics. The local joint affection must be treated by absolute rest, blistering, and mercurial inunction. The most favourable termination will be in ankylosis, which must be treated as described p. 235.

**Cutaneous Eruptions**, chiefly consisting of roseola, with slight pityriasis, and perhaps a few patches of psoriasis with very flimsy scales, occasionally occur in rather severe cases of gonorrhœa, usually appearing from six weeks to three months after the commencement of the attack. They are chiefly diffused about the chest and belly, and present no sign of coppery redness. At the time of their occurrence, the fauces commonly become similarly involved, presenting, as was first pointed out by Travers, a diffused superficial redness on the velum palati and pillars, with perhaps superficial ulceration on these, the tonsils, or the uvula. The occurrence of these affections is usually preceded by slight febrile action, which, however, subsides on their full evolution. The roseolar eruptions occurring during gonorrhœa must not be mistaken for the rash occasionally produced by copaiba.

The *Treatment* consists in the administration of salines, followed by iodide of potassium in moderate doses. Mercurials are not required.

**Gonorrhœa in the Female** differs from the same affection in the male in not being so severe, though it is usually more extensive, and of longer duration. The severity is less, on account of the shortness of the female urethra preventing the occurrence of the retention of urine as in the male, and also from the absence of such parts as the prostate, testes, &c., the implication of which constitutes the principal source of difficulty in men. Gonorrhœa in the female may affect the part to very different degrees; thus, the vulva alone may be implicated, or, as most commonly happens, the inflammation may spread to the whole of the mucous membrane of the vagina. The urethra is less commonly the seat of disease, though occasionally implicated with other parts; and, lastly, the interior of the uterus may become affected by this specific inflammation. In some cases it will even spread along the Fallopian tubes to the ovaries: and ovaritis and fatal peritonitis may also be induced.

The *Symptoms* of gonorrhœa in women are sufficiently well marked in the early stages, when there is an abundant muco-purulent discharge from the parts affected, with a good deal of inflammatory irritation, accompanied with pain in micturition, and a frequent desire to pass urine. As the disease becomes chronic, however, it is more difficult to determine its true character; it being apt to be confounded with some of those accidental and leucorrhœal discharges to which females of all ages are subject.

*Diagnosis.*—In the majority of cases, gonorrhœa may be distinguished from all other *muco-purulent discharges* of the female organs, by the presence of inflammation about the external parts, and the mucous membrane of the vagina and urethra. In these cases it will be found, on introducing a speculum (which, however, occasions considerable pain, and is firmly grasped by the contraction of the vagina), that the discharge comes from the vaginal wall, and that the uterine orifice is free from it, or nearly so; whereas in leucorrhœa the discharge proceeds in a great measure from the interior of the uterus, the os and cervix of which will probably also present signs of diseased action. It must, however, be borne in mind that the discharge in gonorrhœa may occasionally be in a great degree uterine; and that that of leucorrhœa may be an exudation from the mucous membrane of the vagina. In such circumstances, when the disease is chronic, it is almost impossible to arrive at a correct conclusion as to the nature of the case from simple inspection; and in these cases of doubt the Surgeon had better give a very guarded opinion, lest he be led into the error of inculpating an innocent woman. The difficulty is increased, and a good deal of obscurity thrown over the case, by the fact that leucorrhœal discharges will occasionally give rise to urethritis in the male, which closely simulates gonorrhœa. Female *Children* also are occasionally subject to an acute inflammation of the vagina and nymphæ as the result of simple irritation, of constitutional disturbance, or of teething; these cases require to be recognised, as they have frequently been the cause of unfounded accusations.

The *Treatment* of gonorrhœa in the female must vary, according as the disease is acute or chronic. In the acute stage, general and local antiphlogistic means—salines, low diet, rest in bed, and emollient sedative fomentations—must be used. As the disease subsides into a chronic condition, astringent injections must be employed; a weak solution of acetate of lead, or the liquor aluminis compositus largely diluted with tepid water, being especially useful. In other cases, a weak solution of nitrate of silver may be used with much advantage. These injections should be employed three or four times a day and in large quantity. After they have been thrown up, a piece of lint well soaked in the lotion should be introduced between the opposed mucous surfaces, so as to prevent their coming into apposition, the discharge being in a great measure kept up by their friction against one another. In order that the injection may be properly given, the woman should lie flat on her back, and pump in the fluid by means of one of Kennedy's elastic bottles. In the treatment of gonorrhœa in women, specifics are of no use unless the urethra be affected, when copaiba may be given, as in the male.

The disease is apt to degenerate into a chronic gleety condition, leaving a thin muco-puriform discharge, which will continue to be infectious for a great length of time.

### STRICTURE OF THE URETHRA.

Much discrepancy of opinion for a long time existed as to the structure of the urethra, some Surgeons admitting, others denying its muscularity. Though the presence of muscular fibres in the urethra had been suspected by many in consequence of the phenomena presented by some forms of stricture being solely explicable in this way, it is only in recent times that their existence has been demonstrated; Kölliker and Hancock having shown that the tube is surrounded through its entire length with an organic muscular coat. Hancock has demonstrated the course of these fibres. He has pointed out that the fibres of the inner layer of the muscular coat of the bladder pass forwards underneath the mucous membrane of the prostatic portion of the urethra, and those from the outer layer of the muscular coat of the bladder outside the prostate. These two layers join at the membranous portion of the urethra, forming the muscular covering of this portion of the canal. At the bulb, these two layers divide again; the inner lying underneath the mucous membrane, separated from it merely by areolar tissue; the external lying outside the corpus spongiosum, between it and its fibrous investment. At the anterior extremity of the urethra, they unite again and form its lips. Thus the urethra is surrounded through its whole length by muscular fibres, a double layer of which invests it at the membranous portion, and again at the external meatus. The prostate and corpus spongiosum are included between planes of these fibres. The vesicles and ducts of the prostate are surrounded by layers of organic fibre; those of the ejaculatory ducts coming from the organic layer of the vas deferens. These fibres are totally distinct from the common muscular apparatus of the perinæum; and their existence proves the urethra to be, as had often been suspected, a musculo-membranous canal.

By **Stricture of the Urethra** is meant a narrowing of the canal at one or more points. These may proceed from three distinct conditions; viz.—1, Spasmodic Action of the layer of the organic Muscular Fibres situated outside the mucous membrane; 2, Congestion of the Mucous Membrane of the canal; or, 3, Organic Changes in the Mucous and Submucous Tissues, consisting of thickening, induration, or the deposit of plastic matter within them. According as the disease arises from one or other of these causes, it may be termed a *Spasmodic*, a *Congestive*, or an *Organic* stricture. These different forms of the disease having the one condition—narrowing of the urethra—and its consequences, in common, and in practice being often associated together, present so much variety in their symptoms, in the treatment they require, and in the constitutions in which they occur, as to require separate description.

**Spasmodic Stricture.**—The existence of this form of constriction has been much cavilled at. Surgeons, disregarding the evidence of their own senses, and being led away by an imperfect anatomical examination of the urethra, have denied the possibility of spasm of this canal, not being able to demonstrate the existence of any muscular fibres in sufficiently close proximity to the mucous membrane to influence it by their action. The possession of muscular contractility by the urethra is, however, obvious from the facts that a bougie may occasionally be introduced with sufficient ease, but that the Surgeon, on attempting to withdraw it, will find it tightly grasped; so also, occasionally, on introducing the instrument, he will feel it meet with an obstruction, which on steady pressure will yield with that species of quivering that is peculiar to spasm of muscular fibre. Again, the fact that a patient will at one time pass his urine with the most perfect freedom, whilst, if it be rendered acrid or acid by drinking spirits, effervescent wines, or other similar beverages, almost complete obstruction will ensue, tends to prove the existence of an occasional spasmodic constriction of the canal. These facts, though sufficiently convincing to many Surgeons, had failed to carry proof of the existence of spasmodic stricture to others, until the researches of Kölliker and Hancock, which have been referred to, set the question of the muscularity of the urethra finally at rest.

*Causes.*—The causes of spasmodic stricture are generally such conditions as occasion a relaxed and irritable state of system, as long residence in hot climates, especially if conjoined with habitual excesses in drinking, high living and sexual indulgences. The more immediate causes are usually any circumstances that occasion irritation of the urethral mucous membrane, which being propagated to the organic muscular fibres beneath, calls them into activity, and thus gives rise to the spasmodic affection. The most usual of these are those conditions of the system in which the lithates are largely eliminated ; as exposure to cold and wet, by which the action of the skin is suspended ; or too free an indulgence in spirituous and acid liquors—such as red or effervescent wines, beer, or punch—which are well known to give rise to an attack in many constitutions.

*Symptoms.*—In spasmodic stricture we find evidence of narrowing of the urethra, and consequent impediment to the free flow of urine, rapidly supervening under the influence of certain causes, and as speedily subsiding. A patient, for instance, in his ordinary health and passing urine freely, if he take such food or drink as will give rise to a very acid condition of this fluid ; if he be exposed to cold, or get out of health in any way ; suddenly finds himself able only to pass his urine in a small stream by drops with much straining, or may even be seized with complete retention. Under appropriate treatment these symptoms rapidly subside ; recurring, however, on the application of any exciting cause. At the time of the occurrence of this spasm there is often a sensation of weight and uneasiness in the perinæum, with evident irritation of the urethral mucous membrane, as shown by reddening of the lips of the orifice ; in fact, a tendency to a combination of the congestive with the spasmodic form of stricture. There will often be found to be a very slight *organic* stricture in cases of the *spasmodic* form of this disease ; so that, when the spasm subsides, the urethra will not be quite so free as natural.

*Treatment.*—If the patient be suffering from spasmodic difficulty in passing urine, a suppository, consisting of half a drachm of laudanum in a little starch, should be thrown up the rectum, or a full dose of Dover's powder administered, and the warm hip-bath used. As the opium begins to take effect, the urine will usually be passed without much difficulty. The bowels should then be made to act, when the patient will usually be relieved. If the spasm continue, as it often does, for some days or weeks after this, a full-sized bougie should be introduced every second or third day, in order to lessen the irritability of the urethra. In some cases, this is more effectually done by the use of a plated bougie well warmed and oiled. Whatever instrument is used should be of large size, from No. 8 to 10. A small bougie will often be arrested, and will create much irritation, when a large one will pass readily. If the use of the instrument cause irritation and increase of spasm, it is better to omit it entirely, and to trust to constitutional treatment. But the Surgeon must not be discouraged, if the first few introductions of the bougie appear to increase the irritation; as the urethra becomes accustomed to the use of the instrument, relaxation of the spasm will take place. At the same time, the patient's general health should be carefully attended to; the bowels must be kept open, and the diet regulated; all acids, stimulants, and sweets being carefully avoided. During the time when the bougie is being used, he should take the citrate of potash well diluted.

As a *preventive treatment* of these attacks, a careful regulation of the diet, warm clothing with the use of flannel, and keeping the skin in action by means of horsehair gloves and tepid baths, will be found serviceable.

**Congestive Stricture.**—Many Surgeons look upon *spasmodic stricture* as essentially dependent on congestion of the mucous membrane of the urethra, overlooking altogether the existence of spasm, or considering it as the result of irritation of the perineal muscles, and not of the true organic muscles of the canal. That the two conditions of congestion and spasm are frequently associated in the urethra, in the relation of cause and effect, there can be no doubt; and this is the most frequent condition in which spasmodic strictures are found. Indeed, congestion plays an important part in all forms of stricture; it may, as we have just seen, be connected with the spasmodic variety; it may occur alone; or it may be associated with organic stricture. Some parts of the urethra appear to be more subject to congestion than others; thus, for instance, the membranous and prostatic portions, especially the folds of mucous membrane constituting the verumontanum, are peculiarly liable to become congested.

*Causes.*—Congestive stricture frequently occurs as the result of chronic and long-continued inflammation of the urethra, or of the passage of urine that has been rendered irritating by being too concentrated, or by an admixture of an undue proportion of lithates. It is especially in gouty or rheumatic subjects who suffer from irritability of the skin and mucous membranes that this condition occurs. In these cases there is no true or permanent obstruction, but the disease is transitory, and solely due to a swollen state of the membrane of the part. But in the majority of cases it complicates and aggravates seriously spasmodic and slight organic strictures.

*Symptoms.*—In congestive stricture we not only find the common symptoms occasioned by an impediment of the free passage of the urine, but some swelling of the lips of the urethra, with reddening and eversion of them. There is also slight gleety exudation, and not unfrequently an abundant puriform discharge, in fact, urethritis of a marked kind, with a sense of weight or fulness in the perinæum, pain in micturition, and sometimes uneasiness in defæcation. This state of things constitutes a very troublesome affection, intimately connected with the various forms of urethritis, and exceedingly apt to relapse from apparently very trivial circumstances, slight errors of diet, dyspeptic derangements, or any local sources of irritation.

The *Treatment* in these cases should consist in careful regulation of the diet and habits of life, and especially in the administration of the citrate of potash, and the saline aperient mineral waters, as those of Carlsbad or Friedrichshall. If there be much tenderness or weight about the perinæum, the application of leeches to this part, together with the use of the warm hip-bath, will be serviceable.

Congestive stricture, though more influenced by constitutional than by local means in many cases, yet requires the introduction of bougies in order to prevent the constriction from becoming permanent. In some instances a wax, in others a silver or pewter instrument, will be found to answer best. Whatever is used, care should be taken to introduce it slowly and with every possible gentleness. With all care, some hæmorrhage usually follows the passage of the instrument; not from laceration, but simply as the result of compression of the mucous membrane; and the discharge of blood appears rather to be beneficial than otherwise.

**Organic Stricture.**—This, the true form of stricture, is the result either of chronic inflammation of the urethra, leading to thickening of the mucous membrane, or of injury from blows or kicks in the perinæum, by which a portion of it is torn and heals by a contracted cicatrix. Repeated gonorrhœas and long-continued gleets are the most fertile causes of this disease. In the urethra as elsewhere, plastic matter is deposited in and around the mucous membrane in the submucous areolar tissue, as the result of inflammation; consolidation of this takes place, followed by contraction of the canal. The long continuance of inflammation is more to be dreaded than its intensity in occasioning this mischief; hence it is of great importance not to allow gleets to run on indefinitely, as they will almost to a certainty be followed by constriction of some portion of the urethra.

*Age.*—Stricture of the urethra may be met with at any age after puberty. The causes that usually give rise to it seldom come into operation, however, before the adult age; hence strictures are not very common before 25 years of age. Between that period and the age of 40 they most commonly originate, and may then continue for an indefinite period. The earliest age at which I have seen true organic stricture of the urethra has been in a boy 14 years old, when it had already existed for more than 12 months; it was situated one and a half inches from the meatus, and was so tight as only to admit of No. 1 catheter. It was complicated with and had given rise to a fistula in perinæo, through which the greater part of the urine escaped. The boy in whom it occurred could give no explanation of its occurrence, but it was probably traumatic. His attention was first directed to it by a sudden attack of retention. The stricture was hard and gristly, about half an inch long, and required urethrotomy for its relief. There was no calculus.

*Seat.*—The seat of organic stricture varies considerably; indeed, any portion of the urethra may be affected by it, except the prostatic. It appears to be the common belief amongst Surgeons, that the membranous portion of the canal is the most frequently affected by this disease. This, however, there can be little doubt, is an erroneous opinion. H. Smith has examined 98 specimens of stricture contained in the different London museums; of these he found only 21 seated in the membranous portion of the urethra, whilst 77 were anterior to the triangular ligament; the majority of these being either in the bulbous portion of the urethra, or a little in advance of this. Sir H. Thompson, in his excellent work on *Stricture,* states that, in an examination of 320 strictures, he found 215 at the junction of the spongy and membranous portions of the urethra; 51 in the spongy portion, from an inch in front of its commencement to within two inches and a half of the external meatus; and 54 at the external orifice, or within two inches and a half of it. The part most frequently affected is the first inch of the spongy portion; in the membranous portion, stricture is extremely rare. He also states, "I may confidently assert that there is not a single case of stricture in the prostatic portion of the urethra to be found in any one of the public museums of London, Edinburgh, or Paris." Occasionally strictures are multiple, two frequently occurring, and sometimes as many as four or five.

*Characters.*—The characters of organic stricture vary greatly. In some cases it is annular, encircling the whole of the canal, and occasionally for some little distance. The elongated annular stricture usually arises from consolidation of the corpus spongiosum by plastic matter compressing the urethra, as in Fig. 797. In other cases, again, annular strictures may be narrow and sharp-edged, and are then called "pack-thread" or "bridle" strictures; consisting of bands stretching across the urethra (Fig. 798). Sometimes there are several of these in close proximity to one another, leaving merely narrow passages between or under them. These bands occasionally stretch directly across the canal, but at

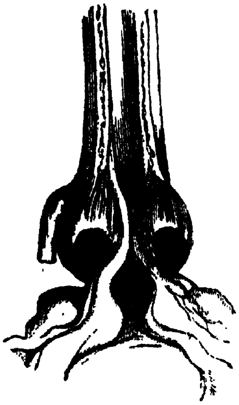


Fig. 797.—Stricture from Consolidation of Corpus Spongiosum.

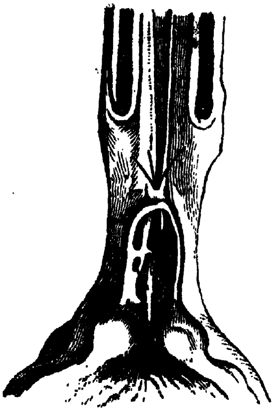


Fig. 798.—Bridle-Stricture.

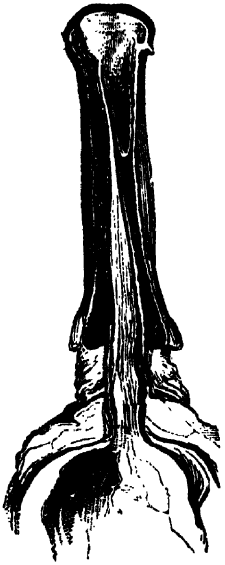


Fig. 799.—Stricture at the Anterior part of the Urethra.

other times and more commonly they take a somewhat oblique direction (Fig. 799). It is not very clear how these bridles or frœna stretching across the urethra are formed. It can scarcely be by the effusion of plastic matter; it is more probable that they are occasioned by a valvular projection of the mucous membrane which has been perforated, perhaps by the point of the catheter, and thus has had apertures produced in it. These various kinds of organic stricture are hard and elastic; sometimes, when old, almost cartilaginous in their density, feeling gristly and rough to the instrument that passes over them.

*Amount of Constriction.*—This varies greatly in organic stricture, from merely slight narrowing of the channel to almost complete obstruction of it. A question has arisen whether the canal of the urethra is ever rendered completely impermeable by a stricture. In answering this, it is necessary to be agreed upon the meaning of the term "impermeable." If by it be meant impenetrable to the passage of a catheter, there can be no doubt that such strictures may occasionally, though very rarely, occur; the channel being so narrow, oblique, or tortuous, that the instrument cannot be passed through it. Strictures, however, of this description may usually be ultimately made permeable to instruments by proper and careful treatment. If by "impermeable" is meant generally impervious to the passage of urine, there can be no doubt that such a condition does not exist. It would clearly be incompatible with life, unless a fistulous opening existed behind the stricture, through which the urine might pass out; and, even with such an aperture existing, I have never heard of or seen a case in which no urine whatever escaped by the meatus, unless in consequence of injury or disease a portion of the whole calibre of the urethra had sloughed away; and it is clear that, so long as any urine passes out in this way, a stricture cannot be looked upon as truly impermeable.

*Mechanical Results.*—When an organic stricture is once formed, it will continue unless removed by surgical means; and, as it usually becomes more closely contracted, it will offer an increasing obstacle to the free flow of the urine, and thus eventually tend to give rise to important structural changes in the urinary apparatus.

The *urethra* behind it becomes increased in diameter, sometimes dilated into a true pouch, in which sabulous masses, and even small calculous concretions occasionally collect. The *bladder*, subjected to increased pressure by the necessity of overcoming the obstacle to the passage of the urine, becomes thickened, fasciculated, and contracted. The *ureters* are often found dilated, from a tendency to a reflux of the urine, or to compression of their vesical orifices, in consequence of the altered structure of the bladder. The *pelves of the kidneys* become the seat of chronic suppuration; and the *kidneys* themselves become irritated, congested, and at last the seat of some of those various secondary changes which have been fully described in Chapter LXVII.

*Symptoms.*—The amount of constitutional disturbance set up by a stricture will vary greatly in different cases. In many, and indeed in most instances, it is not very great. The extent to which the constitution is influenced will generally be in proportion to the tightness and duration of the stricture; but it is surprising how much constitutional irritation is set up in some systems by a stricture, even though it be not very tight. The interference with the free flow of the urine causes irritation of the bladder and kidneys, the secretion from which becomes less abundant than usual; in consequence of this, the actions of the skin and other depurative organs are deranged, and thus the system at large is influenced and suffers. In other cases, again, the constitutional symptoms are rather of a nervous character; the patient suffering not only great pain in micturition, but being seized with rigors, followed by nervous prostration, each time the urine flows over the tender and irritable surface.

The *Local Signs* of stricture are always well marked, are very unequivocal. and are dependent simply on the mechanical obstacle presented by the contracted urethra to the free escape of the urine. The disease usually commences with the retention in the urethra of a few drops of urine after evacuation of the contents of the bladder; these escape and wet his clothes. The patient finds that he has to pass urine more frequently than usual, particularly at night; there is some straining, perhaps a slight gleety discharge, and a feeling of weakness about the genital organs. The stream of urine has changes impressed upon it during its passage through the stricture, by which its shape and direction are modified; thus, it may become forked, scattered, twisted, fan-like, or be discharged in a double current—one projected directly forwards, the other dropping perpendicularly downwards. As the disease advances, these signs necessarily become more marked, until they may terminate in complete retention; they, however, often come on in a very insidious manner, and when the patient seeks advice he is found to be already the subject of a very tight and intractable stricture; indeed, in some cases, the first circumstance that directs the attention of the patient to his complaint is the sudden occurrence of retention of urine.

**Examination of the Urethra.**—The existence of stricture can be determined with certainty only by the introduction of an instrument down the urethra. In exploring the canal in a suspected case, two points have to be ascertained—the existence of a stricture, and its degree of tightness. The *existence of a stricture* may be determined by passing a plated steel sound, or a silver catheter of medium size, about No. 8, well oiled and warmed. This will readily pass as far as the constricted point, but will then be arrested. In this exploration, too small an instrument must not be used, lest it hitch in the fossæ of the urethra or against the verumontanum, and this accidental arrest be mistaken for the obstruction produced by the stricture; or it may pass through the stricture, and thus mislead the Surgeon. The existence of a stricture having been ascertained, the next point is to determine its *degree of tightness.* This is best done by withdrawing the instrument previously used, and then introducing a smaller one about the size of the stream of urine that the patient passes. If this fail to enter the stricture, a smaller one still must be used, until that size is reached, which can be introduced with but a moderate degree of force. In this way the existence, the seat, and degree of tightness of the stricture, are ascertained. The tact of an experienced Surgeon will also lead him to judge to a certain extent of the length, degree of induration, &c., of the constriction.

The slighter narrowings of the urethra are most easily recognised by means of the conical or olive-headed sound (Figs. 800, 801). The conical shape of this instrument enables it to pass readily towards the bladder, but on withdrawing it the shoulder hitches on any narrow part. The instrument should be graduated in inches, so that the exact distance of the stricture from the orifice can be readily determined. If it be desired to recognise more accurately the seat of the stricture, the distance of the orifice of the bladder from the meatus externus must first be determined by carefully passing a graduated "catheter *à boule*," and noting the exact moment at which the urine commences to flow. The graduated olive-headed sound is then passed, and slowly withdrawn. If the hitch or cling be felt between one inch and one and three-quarters, the stricture is in the membranous part. If between one and three-quarters and three inches, it is in the bulbous portion. For the purpose of measuring these slight strictures, Otis, of New York, has invented an instrument which he calls the "urethrometer" (Fig. 802). It consists of a straight tube, the end of which can be dilated into a sort of fenestrated sphere, and the size to which it is dilated is registered on a small dial on the handle. The instrument can be readily introduced into the bladder if necessary, but there is no advantage in so doing. When in the urethra, behind the stricture, the bulb is gradually expanded till it is just held, but not tightly grasped. It is then drawn steadily forward, and when it is stopped the bulb is gradually diminished till it passes the stricture. The exact size of each part is thus registered on the dial.

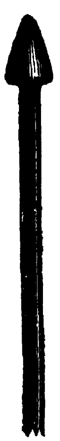


Fig. 800.—Conical-headed Sound.

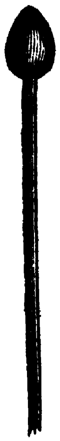


Fig. 801.—Olive-headed Sound.

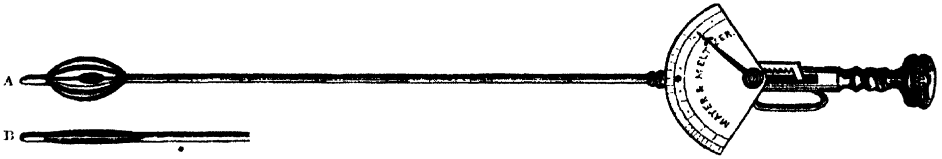


Fig. 802.—Otis's Urethrometer. A. Open; B. End closed.

The employment of soft wax bougies has been recommended with the view of taking a mould of the size, shape, and direction of the stricture, by pressing the end of the instrument into it; but no possible advantage can be derived from this proceeding, and a Surgeon accustomed to the use of metallic instruments can obtain all this information with more certainty by the finer touch afforded by them.

*Treatment.*—The treatment of organic stricture of the urethra may be conducted by the following methods:—1, Gradual Mechanical Dilatation; 2, Continuous Dilatation; 3, Caustics; 4, Forcible Expansion or Rupture; 5, Internal Urethrotomy; 6, External Urethrotomy or Perinæal Section. Whatever plan of treatment be adopted, the Surgeon must bear in mind that his operations have to be conducted upon a tender canal endowed with exquisite sensibility, which sympathises closely with the conditions of the general system, and in which improper violence or too active measures may set up a degree of irritation that will readily extend to neighbouring structures, and thus jeopardise the life of the patient. But, though it is necessary to recollect all this, he must not run into the opposite and equally dangerous extreme of adopting inefficient measures for the removal of the obstruction. A bad stricture is one of the most serious diseases to which the human frame is liable, and will almost inevitably, if left to itself, terminate fatally by the induction of renal disease, or of serious local complications. We must therefore not hesitate to adopt sufficiently energetic measures for its removal; and if these be properly conducted, there is scarcely any affection in which the Surgeon can afford his patient greater relief than in this. At the same time, however, that local means are being used, constitutional treatment should not be neglected. Organic stricture is often more or less associated with a spasmodic or a congestive condition of the urethra, and requires the same constitutional treatment, modified according to circumstances, that is necessary in these affections —proper regulation of diet, avoidance of all articles of food that generate lithates, and care not to allow the urine to become too concentrated. Attention to the maintenance of the healthy action of the liver and skin will also tend much to increase the patient's comfort, and to ward off the more serious consequences of stricture.

In all except the slightest cases of stricture it is advisable, before beginning mechanical treatment, to subject the patient to constitutional remedies to diminish as far as possible the congestion and spasm which may be present. If any serious difficulty be anticipated, and if the circumstances of the patient permit it, he should be confined to bed for a day or more. The bowels should be freely opened, and he should sit for some time in a hot hip-bath, morning and evening. An opium or morphia suppository may be administered at night, and if the signs of congestion be well marked, a few leeches may be applied to the perinæum. Occasionally blisters over the seat of stricture, when it can be clearly felt from without, may be of service. By these means alone, a stricture which at first seemed almost impermeable may be so far relieved as to take a No. 4 or 5 catheter.

1. **Gradual Mechanical Dilatation**, as it is erroneously termed, is the usual and certainly the most successful mode of treating ordinary strictures; but it is not the mere stretching or forcible dilatation of the stricture that cures it. The means employed to produce dilatation tend to promote the absorption of those plastic matters effused in and underneath the mucous membrane, which especially constitute the stricture, and thus to occasion a permanent cure.

The instruments that are used for dilatation are either metallic, such as silver catheters, steel sounds, plated or pewter bougies; or made of some soft and yielding material, as gum-elastic catheters, catgut, wax, or elastic bougies. Though each Surgeon will mostly prefer one kind of instrument to another, it is well not to be too exclusive in the use of any one; for it will be found in particular strictures and certain constitutions that it is advantageous to depart from the ordinary practice, and that the Surgeon may modify with great benefit to his patient the mechanical means that he adopts.

As a general rule, I think that metallic instruments are decidedly preferable, more especially in the early stages of the treatment, and when the stricture is tight, cartilaginous, and of old standing. In such cases, nothing will pass so readily as a well-made steel sound or silver catheter. But, when once dilatation has been carried up to a certain point, for instance, to the introduction of a No. 5 catheter, then some of the other and softer instruments may often be advantageously substituted for the metal one.

The shape and curve of **Catheters** and **Sounds** is of much importance; the best curve for these instruments, I think, consists of one-fourth of the circumference of a circle 4½ inches in diameter. If sounds be used, they should be made slightly conical, so that there may be a difference of about three numbers between the point and the thickest part, which corresponds to the bend of the instrument. They should be well rounded at the point. Sounds are particularly useful when the stricture will admit a moderate-sized instrument. The sound should have a broad metallic handle, which transmits any sensation communicated to the point more accurately than a wooden one. If a catheter be used—and this instrument is most applicable in small strictures, in which, if the difficulty of introduction be great, it may advantageously be left—it should be made very solid and stiff. The rings should be large, so as to serve for a handle, and the eyes well rounded off and somewhat depressed, so that they may not scrape the urethra. These instruments should be used with every possible care and gentleness; but, though no one more strongly recognises than I do the necessity of not employing unnecessary violence in their introduction, it is useless to think of passing through a tight hard stricture without the employment of some degree of force. The catheter or sound will not "find its own way" here as it may in a healthy urethra, but it must be guided and directed by the hand of the Surgeon; and there is scarcely an operation in surgery that requires more tact and delicacy of manipulation than that of passing an instrument through a tight, or, as it is termed, an impermeable stricture. Here some force must be used, but the skill is shown in proportioning this to the amount of resistance, and in using it in a proper direction. The appearance of force is indeed often greater than the reality; for, though the point of the catheter have passed through a tight stricture, it may still require considerable pressure to push the rest of the instrument through it.

*Introduction.*—Catheters and sounds are best introduced by laying the patient flat upon his back, with the pelvis somewhat raised, and the head and shoulders low. The Surgeon, standing on the left side, inserts the instrument well warmed and oiled into the urethra, with its concavity turned towards the left groin, and passes it down the canal, at the same time drawing the penis upwards with his left hand, so as to put the mucous membrane on the stretch. As the instrument approaches the triangular ligament, the handle is carried to the mesial line, and at the same time raised perpendicularly; and, as its point passes under the pubes, it should be kept well against the upper surface of the urethra, and made to enter the bladder by depressing the handle towards and between the thighs. The surest guide to the bladder is the upper surface of the urethra, which is more fixed than the lower, and less liable to the existence of fistulous openings or false passages. Should difficulty be experienced, the introduction may be facilitated by injecting and slightly distending the urethra with olive oil before passing the instrument.

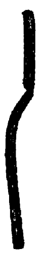


Fig. 803.—Catgut Bougie bent to Shape of Stricture.

If the stricture be not only very tight, but twisted, it may be somewhat difficult to get a metallic instrument through; and then the plan recommended by Brodie may be advantageously employed. This consists in taking a fine catgut bougie, and bending it, as represented in Fig. 803, about an inch from the point, so as to follow the track of the stricture more closely. In this way, strictures that are otherwise impassable may be rendered pervious with comparative ease. Under the influence of chloroform, however, many strictures may be readily passed with metallic instruments that are not pervious in any other way. The Surgeon repeatedly succeeds by its use in passing catheters through very tight strictures, which had been impenetrable for months or years without this agent.

Gum-elastic bougies and catheters, and wax bougies, are not as a rule so manageable as metallic instruments, as they may bend back against tight organic strictures. In those of a spasmodic and congestive kind, however, in which a large instrument will readily pass, they are of much service. They are usually best introduced whilst the patient is standing, and they generally glide most readily into the bladder if they have been slightly curved before being passed. When they are of wax, it is useful to smooth them down between the fingers before introducing them. In using the elastic catheter, a stylet is usually required; but in some cases the instrument appears to enter more easily without. In others, it may be passed with the stylet down to the stricture; and then, on partially withdrawing it, the point of the catheter will start up, and thus more readily slip in.

Soft conical bougies and catheters with *a bulbous end* are often extremely useful (Figs. 804 and 805). Their introduction excites far less irritation and pain, with much less likelihood of bleeding from a congested mucous membrane, than does that of metallic or even gum-elastic instruments. It is, of course, quite impossible to make a false passage with them; and in most cases of ordinary stricture they will be found to be the safest and most agreeable instruments to use. They will often glide through a tight irritable stricture, when all other instruments, especially metallic ones, fail to pass.

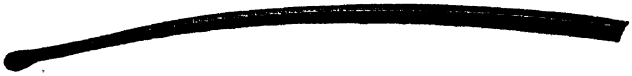


Fig. 804.—Conical Bulbous Bougie.

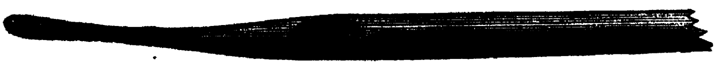


Fig. 805.—Conical Bulbous Catheter.

The *filiform bougie* is another very useful instrument; like the bulbous bougie, it is of French origin. The soft tapering end will frequently insinuate itself along an irritable urethra, and through a spasmodic and congestive stricture, with the greatest possible ease and comfort.

**Results of Introduction of an Instrument.**—The introduction of an instrument usually gives rise to a smarting, painful sensation in the urethra; this is generally most severe as the point approaches the neck of the bladder, and is then sometimes attended by nausea and sudden faintness. As a general rule, the instrument should be passed every second or third day, and when introduced should be left in for about five minutes, or until the spasm of the urethra induced by its introduction has subsided. If, however, the stricture be extremely tight, a very small catheter only having been introduced, the instrument may be left in for twenty-four or forty-eight hours, when it will be found that, however tightly grasped it originally had been, it has become loosened; a slight discharge being at the same time set up from the urethra. It may then be readily withdrawn, and, when the irritation has subsided at the end of a couple of days, a considerably larger one may be introduced.

The augmentation of the size of the instrument should be very gradual. It is fully sufficient to increase it by one number at each time of introduction. Many urethræ will not bear even this, and it becomes necessary to pass the same instrument on two or three successive occasions before a larger size can be introduced. The size of the instrument may be gradually increased until that is reached which the urethral orifice readily admits; beyond this, the Surgeon should not go; but so soon as the full size, usually No. 12 or 14, can be introduced with ease, it should not be passed so frequently as before; once a week or ten days, and gradually with less frequency. But for some length of time it will be necessary to introduce it at least once a month or six weeks, lest contraction take place again.

If the size of the instrument be increased too rapidly, irritation may be set up, and inflammation of the testicles, and abscess in the perinæum or prostate, induced. I have more than once had occasion to regret being in too much haste to increase the size of the instrument; and, by augmenting it by two or three numbers at one sitting, have seen the patient thrown back for weeks by the supervention of some of the affections just mentioned.

By gradual dilatation, properly carried out, most strictures may be considerably relieved in the course of a few weeks; and the majority may be cured by continuing the treatment for a sufficient length of time. Some, however, cannot be cured in this way; it would appear that the tissue of which they are composed is so contractile that, although they may be expanded up to a certain size—say up to No. 5 or 6—it is impossible to go beyond this. In other cases there is a great tendency to relapse, and to a return of the constriction; the stricture rapidly becoming tighter so soon as the introduction of the instruments is discontinued, even though it be dilated to the full size of the urethra, up to No. 12 catheter, for instance. In some instances the relapse is almost instantaneous, micturition being as difficult as before as soon as the catheter is withdrawn. In these cases recourse must be had to other measures, which will be described.

**ACCIDENTS ATTENDING CATHETERISM.**—The introduction of instruments occasionally gives rise to certain troublesome and even dangerous sequences. Amongst these, syncope and rigors, hæmorrhage, and inflammatory irritation about the urethra or testes, are the most common.

**Rigors.**—In some persons there is a great tendency to the occurrence of shivering and faintness during the passage of an instrument, more particularly as it approaches the neck of the bladder. These effects usually go off after the withdrawal of the catheter, but in some cases they may continue for many hours, or even come on after the lapse of some time, perhaps as late as the following day, more especially if the patient have been exposed to cold. The rigors in these circumstances are very severe and intermitting, so much so as to resemble an ague-fit. During the rigor the temperature rises considerably, often to 104° or 105°. The subsidence of the rigor is marked by profuse sweating, and is usually attended by great exhaustion. This occurrence is always very alarming, and, although usually not attended by positive danger, yet leaves the patient weak and exhausted ; and if he be old, of broken constitution, or the subject of chronic uræmia consequent on kidney-disease, a fatal result may rapidly ensue. In these distressing cases, death may occur at different periods and in different ways. The earliest period at which I have seen a fatal termination has been in nine hours ; usually it takes place in from 24 to 48 hours after the occurrence of the first rigor. The cause of death may be coma, exhaustion, or cardiac syncope.

The cause of the occurrence of these rigors and sweatings is exceedingly obscure. Constitutional nervousness or timidity has certainly nothing to do with them. I have seen them occur in the strongest and most courageous men, and they very rarely follow the use of the catheter in women. I have only once seen these effects in the female. That was in the person of a young married lady, strong and healthy, who had a stricture of the orifice of the urethra, which I dilated by a two-bladed dilator. Twenty hours after the operation, she had three most intense rigors followed by profuse sweatings. In men they may occur after dilatation of any part of the urethra, but are most frequent after deep dilatation, possibly because the deeper portions of the canal are more commonly strictured. I have, however, heard of one case in which a fatal rigor followed incision and dilatation of the orifice of the urethra. I doubt whether these rigors occur unless there have been some lesion, abrasion, or rupture of the mucous membrane of the urethra. Rigors certainly follow the use of metallic instruments more frequently than that of the softer kinds. They more frequently occur in old cases of stricture, and are probably then dependent on a chronic uræmic state. In this condition we know that the nervous system readily becomes affected—that coma or convulsions easily occur ; and it is in this state that the additional irritation inflicted on the urinary organs by the use of an instrument developes the rigor.

The *Treatment* consists in wrapping the patient up in blankets, with hot bottles to the feet, and giving hot brandy-and-water, and full doses of quinine with citrate of potash and mucilage frequently repeated. When there is a tendency to rigors, it is well to give a full dose of quinine immediately on the withdrawal of the instrument, as a preventive means.

**Hæmorrhage**, which is sometimes rather profuse, may follow the introduction of a catheter, especially if the stricture be congestive, and the instrument employed small. It generally ceases of itself; but, if it be troublesome, the application of cold will check it.

The **Inflammation** about the urethra and in the testes that occasionally occurs during the treatment of stricture, is best guarded against by not using too large catheters, and by directing the patient to abstain from much exercise during the time of their introduction.

**False Passages** are occasioned by the instrument passing out of the urethra through its coats into the surrounding tissues. They are especially apt to occur in tight bridle-strictures, when a small instrument is being used, and more especially if the direction of the constriction be somewhat oblique, so that the point of the sound is thrown against the side of the canal (Fig. 798). The extent and situation of a false passage necessarily vary according to the position of the stricture; and the danger is usually in proportion to its depth. The false passage usually takes a direction downwards and to one side of the urethra. If the stricture be far forward, it may run along the corpus spongiosum; but if it be in the usual situation, it may perforate the lateral lobe of the prostate, or run between this and the rectum, being unable to extend upwards on account of the rigid nature of the structures in this situation. When the false passage merely perforates the corpus spongiosum, running parallel to the urethra, and opening again into the canal, or when, perforating a portion of the prostate, it enters the bladder, it is not necessarily attended with much danger; but when it enters the areolar tissue between the bladder and the rectum, breaking up this structure to a great extent, admitting urine into the recto-vesical space and about the neck of the bladder, then the most serious consequences, such as inflammation and abscess in this neighbourhood, are apt to ensue, which may not unlikely be followed by the death of the patient.

At the moment when a false passage is made during the introduction of an instrument, by the Surgeon using too much force or pressing in the wrong direction, he feels the point make a sudden slip, which the direction of the shaft indicates to be to one side of the urethra. The patient complains of severe pain, and is often conscious of a laceration; there is a grating or rough sensation communicated by the tissues against which the instrument has passed; and though it have entered deeply, it will be found not to have reached the bladder. On the Surgeon introducing his finger into the rectum, he probably feels the point of the instrument in the areolar tissue between the gut and the bladder; on withdrawing it, it will be found covered with blood, and there will be free hæmorrhage from the urethra.

The Surgeon knows when he has entered an old false passage by the change that takes place in the direction of the instrument, by its not reaching the bladder, and by the rough sensation communicated to it, very different from that afforded by the smooth lining of the urethra. The patient is often conscious of the existence and of the entry of the instrument into the false passage, and will warn the Surgeon of it.

If the Surgeon be aware that he has made a false passage, he should, if possible, at the time of the accident pass a large catheter into the bladder, and leave it there for a few days until the laceration has healed. If there be an old false passage he must be careful, by keeping the point of the instrument away from it, not to enter it, lest during the introduction of the catheter he raise with the point of the instrument the valvular angle that intervenes between it and the urethra; every time that this is opened up it tends to lessen the chance of a closure of the aperture, whilst, overlapping the urethra, it interferes with the onward passage of the instrument into the bladder. By withdrawing the instrument and changing its direction, the false passage may often be avoided, and the bladder reached. Should there have been much difficulty in introducing the catheter, the better plan will be to allow it to remain in the bladder for two or three days, when the false canal may possibly close.

It has already been stated that, in certain forms of stricture, gradual dilatation does not succeed in effecting a permanent cure. In these cases four plans of treatment have been recommended—continuous dilatation, the destruction of the stricture by caustic, forcible dilatation, and its division by the knife. These methods will now be described.

2. **Continuous Dilatation** is merely a modification of the preceding mode of treatment, and is useful only in very tight organic strictures. A small instrument is first passed and tied in. In from twelve to twenty-four hours, although it may at first have been tightly grasped, the catheter will be found to be quite loose, and urine will escape beside it. It must now be changed for a larger one. In doing this, the fresh instrument should be ready, so that the moment one is removed the other may be introduced. A neglect of this precaution, especially when false passages are present, may seriously increase the difficulty of passing the fresh catheter. By the second day a slight discharge will be found to have been set up from the urethra. The treatment should be continued till the urethra reaches the size of No. 5 or 6, which it will do in a few days at most, after which it is not necessary. The catheter may be closed with a small wooden plug, so that the patient can draw off his own urine, or, better still, an India-rubber tube may be attached so as to drain the bladder. In cases in which a gum-elastic catheter cannot be passed, a small silver one may be tied in, and replaced by a gum-elastic at the first change. When nothing but a filiform whalebone or catgut bougie has been passed, it may still be tied in, as the urine will usually find its way beside it even when it seems to be tightly grasped; and in twelve hours or more it may, in most cases, be changed for a fine gum-elastic catheter. This plan of treatment is of great use in cases in which considerable difficulty is found in introducing the instrument, but it has the disadvantage of being extremely liable to set up cystitis. If the treatment be continued beyond three days, the urine will almost always be found to be alkaline; and this is scarcely to be wondered at when we consider the way in which the bladder is, as it were, opened up to the air. The risk of cystitis is much diminished by draining the bladder, as then no urine is left to decompose, and the mere contact of the soft instrument with the walls of the bladder seems to cause but little irritation by itself. In rare cases, sloughing of the urethra may take place at the seat of stricture, leading to perineal abscess. A case of this kind occurred not long ago in University College Hospital.

3. **Caustics.**—In the treatment of stricture by caustics, two objects are endeavoured to be attained; the first is the destruction of the stricture; the second, the diminution of the sensibility of the surrounding mucous membrane,

so that the irritability and spasm of the canal may be lessened. The following is the way in which the caustic is applied. A wax bougie, well oiled, is passed down to, but not through the stricture ; the Surgeon then, with the thumb-nail, makes a notch on that portion of the instrument opposite to the meatus. Another bougie of similar length and size is then armed by a piece of potassa fusa about the size of a small pin's head, placed in a depression at its end. A mark is now made on it, at a point corresponding to the notch on the first bougie ; it is then passed rapidly down until this mark comes opposite to the meatus, and pressed firmly for two or three minutes against the stricture, upon which the caustic exercises its action. This application, which is followed by a gleety discharge, is to be repeated every second or third day until a bougie of proper size can be introduced ; and then the dilatation may be proceeded with in the usual way. This practice, stigmatised, not unjustly, by Liston as " most atrocious," has now but few advocates ; and, indeed, there appears to be nothing useful effected by it, beyond what can be accomplished much more safely and easily by a catheter or sound in an ordinarily skilful hand.

4. **Forcible Expansion or Rupture.**—Forcible and rapid dilatation causing the expansion and rupture of the stricture, is a method that, originally proposed and practised many years since by Luxmoor, Arnott, and Buchanan of Glasgow, has of late years been revived in principle, and ingeniously modified in detail, by many Surgeons, amongst whom Reybard, Maisonneuve, Perrève, Wakley, Holt, and Thompson are the most conspicuous. However varied the means by which strictures are thus treated, the instruments employed may be arranged in three groups : *a.* Those that act as sliding tubes ; *b.* Those that expand by a screw mechanism ; and *c.* Those that act on the principle of a wedge.

*a.* *Sliding Tubes* were first employed in the treatment of stricture by Desault at the close of the last century, subsequently by various French Surgeons, and of later years by Hutton of Dublin, and very extensively and successfully by Wakley. The mode of application of these tubes is as follows. A long conductor is introduced through the stricture into the bladder, and over this a catheter, either of gum or silver, is passed, which in its turn is made to serve as a conductor to a larger one. In Wakley's instrument the conductor, or " urethral guide," consists of a small silver catheter, which, after being passed through the stricture, has a long steel rod screwed into it. Over this a silver tube is passed, which in its turn is made to serve as a conductor ; and thus the conductor may be rapidly dilated by passing one tube over another until a full size is reached. The only difficulty in this very ingenious method—which is, however, common to it and every other plan of treating stricture by dilatation—consists in the first introduction of the " urethral guide ; " when that has once passed through the stricture, the tubes must follow as a matter of necessity. They cannot possibly go wrong ; and, as no laceration or rupture of the stricture is, or can be, effected by the instrument, it appears to be a peculiarly safe means of employing rapid dilatation when circumstances seem to require it.

*b.* The method of forcibly expanding a stricture by the introduction into it of a small two- or four-bladed instrument, fashioned somewhat like a narrow beaked sound, and which, by *Screw Mechanism* in the handle, admits of being opened out so as to stretch the stricture to an extent corresponding to the distance at which the blades are screwed apart, has many advocates; and various ingenious contrivances have been invented to effect this object. More than half a century ago, Luxmoor attempted it by the use of a four-bladed instrument. Subsequently, Civiale invented a stricture-expander; and of late years two-bladed instruments, having this end in view, have been introduced into practice by Perrève, Lyon, and H. Thompson. The accompanying drawing (Fig. 806) is a representation of the instrument used by the latter Surgeon; it answers admirably the intended purpose, the expansion of the blades being effected by a screw worked by turning the handle. This should be done very slowly, several seconds being allowed to elapse between each turn of the handle, so that the tissue composing the stricture may be gradually stretched, and the canal of the urethra at the seat of stricture dilated beyond the full size, so as to be over-stretched; the extent of dilatation may be carried up to 16 or 18, and is marked on a scale attached to the handle of the instrument. If this operation be done slowly, little if any bleeding results, and there is no evidence of laceration of the wall of the urethra at the strictured spot. A large gum-elastic catheter may then be passed, and the urine drawn off. It is not usually necessary to leave the catheter in the bladder, though there can be no objection to doing this for forty-eight hours, after which the patient may have one passed occasionally in order to maintain the dilatation.

Fig. 806.—Thompson's Stricture-Expander.

*c.* The rupture or splitting of the stricture by an instrument acting on the principle of a *Wedge*, has been recommended by Reybard, adopted by Holt, and very extensively employed by the latter excellent Surgeon. The instrument used by him is represented in the accompanying figure (Fig. 807). It consists of two grooved metallic blades joined at the extremity. Between these a tube is slipped along a wire, which in its descent separates the blades at a considerable angle, and thus splits up the stricture. In this way the contracted part of the urethra is at once enlarged to its normal diameter, so as to admit a full-sized catheter, by which the urine is then drawn off. The introduction of the catheter should be had recourse to at first on alternate days, and afterwards at longer intervals. Holt believes that the effects of the dilatation are entirely confined to the morbid contraction, the healthy portion of the urethra not being injuriously disturbed by the expansion of the instrument (see page 746).

Fig. 807.—Holt's Instrument for Splitting Strictures.

Berkeley Hill has invented a modification of the dilators previously in use which presents several advantages. He thus describes it. "The instrument consists of a split sound, which equals in calibre a No. 2 or 3 catheter. The halves of the split sound can be separated by passing between them a wedge fixed on a slender stem. The wedge is prevented by two dovetail grooves at its hinder part, from leaving the sound which acts as a guide during the passage of the wedge down the urethra." "The advantages claimed for this instrument are: simplicity of construction; the central guide of Holt's instrument is not needed, hence the split sound can be passed through narrower strictures. Next and chiefly, diminution of resistance, and consequently the more immediate application of the rupturing force—the wedge—to the impediment to be overcome. The force needed to push Holt's dilator is sometimes very great, and the attempt has been abandoned, or the instrument has broken, even in skilful hands, from this cause. Much of the force is expended on the continuous friction outside the tube along the split sound, and inside along the guide. In the wedge-dilator the friction-surface is reduced to two dovetail grooves, which together do not exceed half an inch. For this, the force required is so small that one hand suffices to overcome the resistance." The instrument can, if required, be adapted to a conducting sound, such as is described afterwards under Internal Urethrotomy.

4. **Division of the Stricture** may be practised either from *within* the urethra, or from *without*, through the perinæum.

**Internal Urethrotomy.**—The division *from within* may be performed in two ways; either by cutting through the stricture from before backwards, or by passing a proper instrument through it, and dividing it from behind forwards.

The first operation—that of perforating the stricture *from before backwards*—may be performed by passing a concealed steel stylet down to the stricture, and then pushing forwards the lancet-like knife, attempting to perforate the obstruction. This plan is necessarily attended by the most dangerous consequenees, if an attempt be made to thrust a stylet through the stricture without a guide; the probability, indeed almost the certainty, being that the pointed cutting blade will pass by the stricture and divide the healthy wall of the urethra. It is, indeed, almost banished from surgical practice, and is only applicable with safety to those strictures that are situated in the part of the urethra anterior to the scrotum, where the canal is straight. In the deeper and more curved parts, any attempt at perforation would obviously be fraught with danger; for, as it would of course be impossible for the Surgeon to guide the stylet exactly in the direction of the urethra, it would be more likely to perforate the walls of this canal than to pass through the stricture. In hard and resisting contractions, however, in the straight portion of the canal anterior to the scrotum, such an instrument may occasionally be used with advantage. A very con-

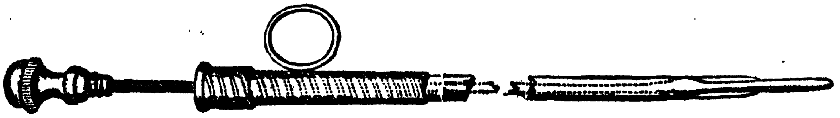


Fig. 808.—Lancetted Stylet for Division of Stricture.

venient form of cutting stylet is the one figured here, which has a probe end, that is introduced through the stricture, and serves as a guide to the blade, which is projected and caused to retract into its cylinder by the action of a spring (Fig. 808).

The other mode of dividing strictures within the urethra is by cutting *from behind forwards.*

During the last few years, great improvement has been made in the instruments employed in this operation, and it has consequently risen much in favour. Cutting from before backwards without a guide proved so dangerous, that it has been finally abandoned. On the other hand, the operation of cutting from behind forwards could not, until recently, be performed unless the stricture was capable of admitting a No. 5 at least. The Surgeons to whom we are most indebted for improvements in the instruments employed, are Van Buren, Gouley, and Otis of New York, Maisonneuve of Paris, and Berkeley Hill of London. The objects which these Surgeons have had in view have been, first, to provide a safe and certain guide for a small cutting instrument to the bladder, and secondly, so far to diminish the size of the instruments as to make them available for strictures not capable of taking more than a No. 1 catheter. Lastly, as it was found that the great mobility of the urethra rendered it difficult in many cases to divide the stricture, a combination of stretching and cutting was introduced by Otis, which greatly facilitates the operation.

The guide to the bladder may be obtained in two ways. A fine whalebone bougie having been passed through the stricture, the urethrotome may be so constructed by being tunnelled for a short distance at its point, as to slide over this into the bladder. Or a better plan is the employment of Maisonneuve's *sonde conductrice,* or conducting sound. This is a very fine gum-elastic bougie, provided with a male screw at the end (Fig. 809, *a*). This is first passed on till it is supposed to be in the bladder. A small catheter corresponding to a No. 1, having a female screw at its extremity, is then screwed on and passed onwards, while the small conducting sound coils up in the bladder. If the urine flow, it is then certain that the conducting sound has passed in the proper direction. It is now withdrawn again, the conducting sound being left in position. The catheter is now replaced by the urethrotome, which screws in the same way. Berkeley Hill has invented a very ingenious urethrotome for cutting from behind forwards, in which a very fine knife can be protruded from an instrument not larger than a No. 2. Another instrument invented by the same Surgeon for cutting from before backwards is represented in Fig. 810. It combines the principles of several others, and has been found to work most successfully. It is thus employed. The conducting sound having been passed and ascertained to be in the bladder, the female screw

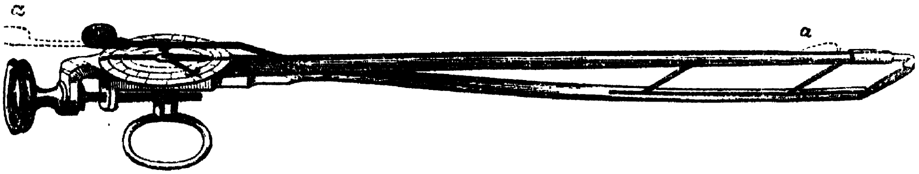


Fig. 809.—Otis's Dilator and Urethrometer.

*b* is applied to the male screw *a*, and the instrument passed through the stricture. The blades *i* and *h*, when closed, about equal a No. 3 catheter in size. The point *b* is about equal to a No. 1. The instrument having been passed, the wedge *e*, which contains a knife *d* concealed in a shield *c*, is now inserted between the blades and passed steadily down. The blades thus separated stretch and steady the urethra; and when the stricture is reached, the shield *c* stops against it and prevents further progress. The small concealed knife *d* is then protruded by pressing the button at the top of the instrument, and as soon as the finger is removed it is withdrawn again by the spring *l*. The wedge can then be passed on a little further, and if it hitch again the knife can be again protruded. By this means the urethra is only cut at the points of stricture, and no more wound is made than is absolutely necessary. The incision is always made downwards towards the floor of the urethra. This instrument may be employed in almost any stricture that will admit the conducting sound.

In larger strictures Civiale's urethrotome (Fig. 811) may be used. In order to use this instrument, the stricture must be dilated up to about No. 5. The end of the instrument is then passed beyond it, and, the small blade having been made to project, the stricture is divided or notched downwards by a firm and steady pressure to the extent usually of about an inch. The blade is then shut into its sheath, and the instrument is withdrawn. As this instrument does not steady the urethra, the penis must be pulled forward so as to put it on the stretch before the division is attempted, and this should be done by a steady pressure or a sawing motion rather than by a sudden effort.

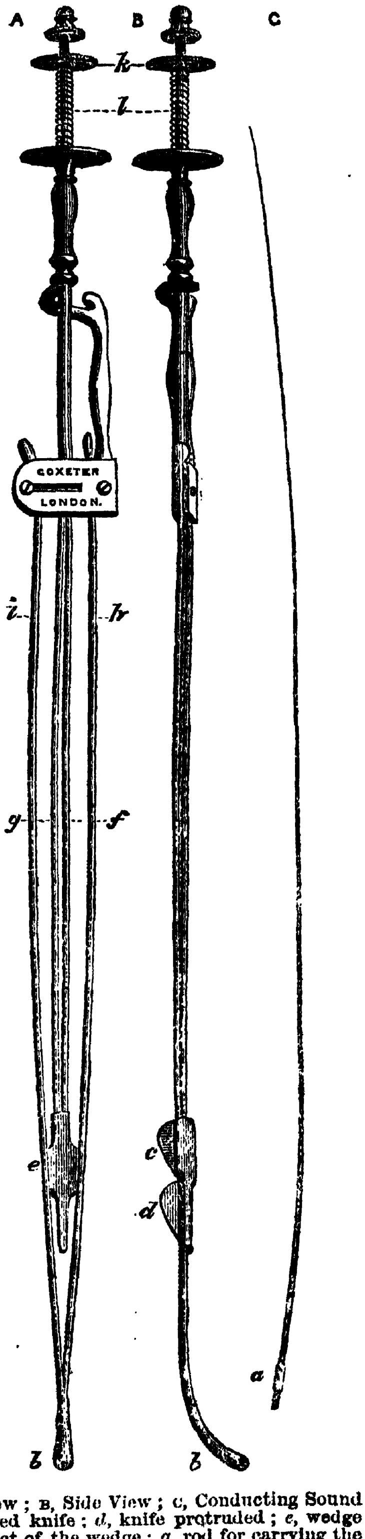


Fig. 810.—Berkeley Hill's Dilator and Urethrotome. A, Front View; B, Side View; C, Conducting Sound with small male screw at *a*: *b*, female screw; *c*, sheath for concealed knife; *d*, knife protruded; *e*, wedge for separating the blades *h* and *i*; the knife is on the posterior aspect of the wedge; *g*, rod for carrying the wedge; *f*, rod for protruding the knife; *k*, screw for regulating the distance to which the knife can be protruded; *l*, spring to draw back the knife and keep it concealed, except when protruded by pressing the button opposite A and B. (In Fig. B the button should have been represented as depressed.)

After the operation of internal urethrotomy, a full-sized instrument should be immediately passed, but it is not usually necessary to tie it in. It should, however, be passed daily for a few days, and after that every second or third day for three or four weeks. After that, the patient should be taught to pass it for himself, and continue to do so occasionally for some years.

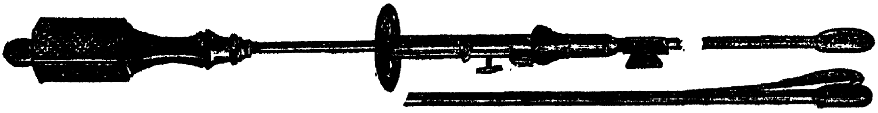


Fig. 811.—Civiale's Urethrotome.

The operation of internal urethrotomy is of course only required in exceptional cases. These are chiefly resilient or very irritable, and some very tough strictures. In resilient strictures, dilatation fails because the stricture, though admitting of expansion, immediately relapses. In very irritable strictures, the patient cannot bear the pain of dilatation. In some very tough strictures, simple dilatation fails, and then internal urethrotomy is required. In all these cases, the division of the stricture from within removes at once all difficulty in treatment; and I have of late years employed this very simple method in several cases of this kind with the most marked and permanent success. In fact, in strictures of the scrotal or penile portions of the urethra, where one or other of the above conditions—resiliency or irritability—generally prevails, I now very commonly notch the constricted portion of the canal by means of Civiale's urethrotome, and thus at once, and with great ease, obtain most, if not all, the space required.

*Result.*—The risk attending the operation is not great, and diminishes as the stricture approaches the orifice of the urethra. It is not, however, absolutely free from danger. The accidents that may happen are, perineal abscess, extravasation of urine, hæmorrhage, and orchitis; and in some rare cases it may be followed by pyæmia. If the kidneys be diseased, it may, like any other operation for stricture, give rise to fatal acute interstitial nephritis. Perineal abscess usually results from cutting too deeply, so that the knife completely divides the corpus spongiosum. Such abscesses most frequently form beneath the accelerator urinæ, and burrow forwards, directed by the expansion of that muscle to the root of the penis. They contain a mixture of urine and pus, but it is rare to find general extravasation into the scrotum. Hæmorrhage also results from cutting too freely. In rare cases, after the operation, a permanently bent condition of the penis remains during erection. We possess as yet but few trustworthy statistics of the results of internal urethrotomy, and there is every reason to believe that untoward consequences follow this operation more frequently than some of its advocates are willing to admit. Statistics of this operation done in private are worthless; those of cases occurring in Hospital practice scarcely exist. In University College Hospital, where the operation has been extensively practised, I find from the Reports of the Surgical Registrar that the results are as follows. In 76 cases operated on from 1871 to 1875, there were 4 deaths, one from tubercular disease of kidneys, lungs, &c., one from pleurisy, one from septicæmia, and one from suppurative nephritis. Perineal abscess occurred in 8 cases; extravasation of urine in 1, and epididymitis in 4. There was hæmorrhage in 5, and in 2 the patient was left with permanent chordee during erection.

(For the effects produced on the kidneys by splitting strictures and internal urethrotomy, see Chap. LXVII.).

**External Urethrotomy.**—The division of the stricture *from without* by incision through the perinæum, may be performed by two distinct operations; the one being only applicable to those strictures that are pervious to an instrument; the other to those which are impermeable. In the first case a grooved staff is passed through the stricture, and the section is made upon this. In the second case, the Surgeon cuts through this and the stricture, without any guidance except such as his anatomical knowledge may afford.

**Operation for Permeable Stricture.**—The first of these operations, introduced by Syme as *Urethrotomy*, and commonly called the *Perineal Section*, is comparatively a simple procedure. The instruments required for its performance are a staff, a No. 8 silver catheter, a pointed scalpel, and a broad director. The staff should vary in size from No. 1 to No. 6, according to the tightness of the stricture; it should be grooved along its convexity, either the whole of the way, or better, merely for the lower third (Fig. 812). The stem is smooth and of full size, and joins into the lower grooved part by a distinct shoulder, which, being passed down as far as the stricture, forms by its projection a guide to that part of the urethra requiring division. In those cases in which there are false passages, a hollow staff of the same size and shape may be advantageously used; the flow of urine through it indicating with certainty its passage into the posterior part of the urethra.

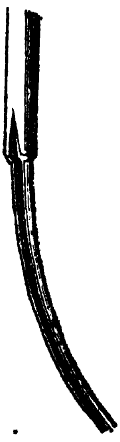


Fig. 812. Shouldered Staff for Perineal Section.

**Performance of Perineal Section.**—The operation is performed as follows. The staff having been passed well through the stricture, so that the shoulder rests against the upper part of the constriction, the patient is tied up as for lithotomy, and the Surgeon, seating himself in front, pushes the scalpel, with the back of the blade downwards, into the mesial line of the perinæum a little above the rectum, and cuts upwards for an inch or more into the raphe. The dissection is carried on very carefully exactly in the median line until the staff is reached, when the knife must be entered into its groove *behind* the stricture, and carried forwards through this. The staff, having been pushed on to ascertain that all is free, must be withdrawn, and a No. 8 catheter introduced, which is to be kept in for forty-eight hours; it must then be taken out, and at the end of eight or ten days the urethra must be dilated by the introduction every second day of a full-sized silver catheter. Urine escapes for some little time by the perineal incision; but, as this heals by granulation, the flow of fluid gradually lessens and at last ceases entirely.

The principal points to be attended to in this operation are—

1. To see that the staff is fairly through the stricture, and to be especially careful in determining this if false passage exist.

2. To cut carefully in the median line ; where, as Syme has observed, a kind of septum exists even in the deeper structures of the perinæum, and where there can be no danger whatever of dividing any artery of magnitude, which might happen if any lateral deviation of the knife took place. The only vessel, indeed, which is at all endangered, is the artery of the bulb ; and this may always be avoided by carefully keeping in the raphe, as it lies towards the side of the incision.

3. To enter the point of the knife behind the stricture, and to divide that by cutting forwards in the groove of the staff.

4. Not to turn the edge of the knife downwards ; if this be done, the deep perineal fascia may be opened, and danger of pelvic infiltration and inflammation incurred.

5. Much difficulty has occasionally arisen in the introduction of the catheter into the bladder after the division of the stricture. This may be avoided by passing a broad director, with the groove turned up, into the posterior part of the urethra after the stricture has been cut, but before the staff is withdrawn. As the catheter is passed down the canal, its point will infallibly be guided by this onwards into the bladder.

Where there are more strictures than one, the division of the deepest is usually alone necessary ; the others may be dilated.

*Result.*—The result of the perineal section, so far as the life of the patient is concerned, is usually satisfactory ; yet cases have not unfrequently occurred in which a fatal termination has been the consequence, and there is every reason to believe that these cases have been more numerous than the advocates of this operation have been willing to admit. As yet, there are no trustworthy statistics before the profession that would enable us to speak positively as to the percentage of deaths after this operation. Occasionally, an incurable fistulous opening has been left in the perinæum ; and not unfrequently accidents of a grave though not fatal character, such as inflammatory œdema of the scrotum, abscess in perinæo, &c., have been found to supervene.

The whole value of urethrotomy will at last depend on the liability of the stricture to return after its division ; and this point has not as yet been by any means satisfactorily determined. The ultimate result of the cases in which it has been practised has not as yet been fully laid before the profession ; and, until this has been done, we cannot consider the utility of the operation as established, except as a means of temporary relief in cases of the kind just mentioned. Much will certainly depend upon keeping up dilatation of the urethra for some months after the division of the stricture, a catheter of full size being passed once in a week or ten days. If this precaution be neglected, relapses will often occur ; and even when it is scrupulously attended to, they are, I believe, by no means unfrequent. Against urethrotomy it has been argued that, like a wound, the incision into the urethra might occasion a cicatrix which would contract, and thus eventually tend still further to lessen the diameter of the canal. But *post mortem* examination of patients who have died some years after this operation had been performed has shown that the idea is groundless, the cicatrix being linear and scarcely perceptible. In fact, there is a great difference in the result, between cases in which the urethra has been divided transversely and those in which it has been incised longitudinally.

In the first instance, a dense and contractile cicatricial mass is formed; in the second case, a linear and scarcely perceptible scar.

**Comparison of Methods of Treatment.**—Gradual dilatation, carried on with patience and gentleness, if need be, on account of the irritability of the urethra or the sensitiveness of the patient, with the help of anæsthetics, will suffice for the cure of the vast majority of strictures; and it rarely becomes necessary for a Surgeon who combines patience with skill to have recourse to those more severe methods of treatment which have been somewhat unduly extolled and too often unnecessarily practised of late years. The urethra is indeed frequently treated as if it were an inert tube, to which the various practices of rupture, splitting, forcible dilatation, or incision, could be applied with impunity, rather than a highly sensitive canal, very apt to resent, locally or constitutionally, undue violence applied to it.

But, whilst we fully recognise this important point, and hold with Liston that whenever a catheter can be got through a stricture its cure by dilatation is all but certain in the hands of a skilful Surgeon, yet it is undoubtedly the fact that cases do occasionally occur in which simple dilatation fails to effect a cure; the stricture being highly contractile, and not allowing expansion beyond a certain point, or relapsing whenever the dilating means are removed. In other cases, also, the patient suffers so much pain and irritation whenever an instrument is passed, that he cannot bear the repeated introductions that are necessary, more particularly if the stricture be complicated with fistulæ in perinæo or false passages, which render its cure by dilatation tedious and almost impracticable. In such cases as these the Surgeon, being unable to benefit his patient materially by dilatation, must choose between the employment of palliative means or more active measures.

It appears to me that there are four classes of cases, in which more energetic means than simple dilatation may not only be advantageously employed, but are absolutely required.

1. *Very old dense cartilaginous strictures,* often of traumatic origin, which admit an instrument with great difficulty, and cannot be dilated beyond a certain point, owing to the conversion of the urethral structures into a kind of dense, fibrous, almost cicatricial tissue, which neither admits of expansion nor of absorption by the pressure of instruments; and in which a considerable extent—half an inch or more—of the urethra is involved.

2. The same kind of stricture, complicated with *fistulæ* in the perinæum or scrotum, with perhaps considerable plastic infiltration of these parts. In both these classes, I think that the perineal section or external urethrotomy is the preferable operation.

3. Very *tight strictures,* accompanied by *excessive sensibility* of the urethra; in which each introduction of the instrument is attended by intense suffering, spasmodic movements of the limbs, and rigors, so that the patient cannot be induced to submit to a proper course of bougies.

4. Very *elastic,* though perhaps *narrow strictures,* that can be dilated readily enough, even up to the admission of full-sized instruments; but which, when the treatment is discontinued, immediately begin to contract again, so that the patient is never out of the Surgeon's hands, and sees no prospect of cure.

In these last two classes of cases, I am of opinion that internal urethrotomy with Civiale's instrument, or the forcible expansion or rupture of the stricture, is the best method of treatment; the perineal section being too severe and dangerous, whilst simple dilatation is too feeble a means of treatment.

**Stricture of the Urethral Orifice** is usually the consequence of the destruction of tissue by a phagedænic chancre. It is apt to become extremely tight, and has a great tendency to relapse.

It may be treated in three ways—

1. By *gradual* dilatation, by means of short nail-headed styles of graduated sizes.
2. By *rapid* dilatation. This is best effected by the introduction of a tube of *laminaria*, which, swelling up in a few hours, rapidly dilates the stricture.
3. By *division* with Civiale's instrument, introduced shut, and cutting as it is withdrawn (Fig. 813).

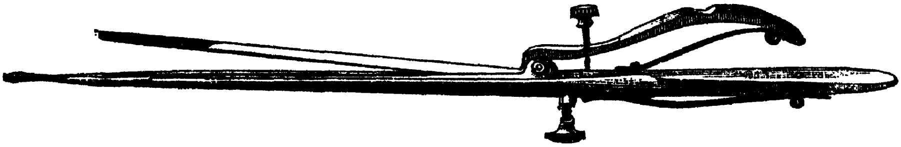


Fig. 813.—Civiale's Urethrotome for Stricture of the Orifice, modified.

Either of the last two methods may most advantageously be adopted.

**Impermeable Stricture.**—In order to perform the perineal section, the stricture must be pervious to a grooved staff, however small this may be; and this, it might be supposed, would limit materially the cases in which the operation can be performed. But complete obliteration of the urethra cannot take place except as the result of sloughing, usually from injury; indeed "impermeable" strictures, though frequently spoken of, are very rarely met with. Syme, indeed, denied their existence, and stated that, if urine can escape through a stricture, a bougie can be introduced. A Surgeon may often be foiled in his first attempts in passing an instrument through a very tight stricture. But I believe that, with patience, by attention to constitutional treatment, so as to lessen urethral irritation, and especially by the administration of chloroform, he will usually at last succeed in making an instrument of some kind pass through the very worst strictures. In the first case in which I performed the perineal section, almost all the urine had for twelve years been discharged through fistulous openings in the perinæum and scrotum; and the principal portion escaped through a large hole on the inside of the left thigh, a few drops merely occasionally passing out by the lips of the urethra. No instrument had been passed for four years, though repeated attempts had been made by different Surgeons. Being foiled in introducing a catheter into the bladder the first time I tried, I kept the patient in the Hospital for two or three weeks, attending carefully to his constitutional condition, but without making any further effort. He was then placed under chloroform, when I succeeded in passing No. 1. The urethra was then dilated up to No. 5, beyond which no instrument could be passed, when the perineal section was performed. The patient made an excellent cure, the fistulous openings closing, and the urine being discharged by the natural channel. In another case, persevering attempts had been made for five years to make an instrument enter the bladder, but without success, the stricture not only being excessively tight, but the urethra acutely sensitive ; under chloroform I succeeded in introducing No. ½ silver catheter into the bladder, and speedily cured the patient.

The influence of *Anæsthetics* in facilitating the passage of instruments through apparently impermeable strictures is very marked. Shortly after the introduction of ether as an anæsthetic agent, Liston was going to cut through a stricture that had resisted all attempts made by his most dexterous hand at introducing an instrument into the bladder ; but no sooner was the patient put on the table and fairly rendered insensible, than the No. 8 silver catheter, which had been passed down as far as the stricture, and the point of which was to serve as a guide to the knife, slipped into the bladder, and thus rendered a dangerous operation unnecessary.

Yet no Surgeon can doubt that cases do occasionally, though rarely, occur, in which, in consequence of extravasation of urine and old inflammatory action, the urethra has become so tortuous and narrow, and the perinæum so indurated and disorganised, that an instrument cannot be passed through, even though the urine pass out readily. It must be borne in mind that a stricture may be permeable to urine, but impermeable to a catheter, even in the most dexterous hands. It does not follow necessarily that, because a fluid will trickle out of a narrow and tortuous channel, a catheter or solid sound can be passed into it from without. In a case of extravasation of urine following stricture, consequent on injury of the perinæum, sent to me by Corrie of Finchley, in which no catheter had been introduced for eight years, it was found after death that, although the urethra had been converted into a mass of cicatricial tissue at the part injured, it was yet permeated by a narrow tortuous passage, through which the urine had escaped.

Hence cases will occasionally occur, in which the perineal section is not practicable. In the event, therefore, of a stricture being so tight and tortuous that no instrument will pass through it, or where, a portion of the urethra having sloughed away, its canal is obliterated, neither the cure by dilatation nor urethrotomy can be performed, and it may then be necessary to have recourse to incision of the stricture without a guide.

**Operations for Impermeable Stricture.**—Two operations are practicable for the relief of this constriction. The first consists in opening the urethra *from behind*, and cutting forwards through the constriction ; the second in opening the urethra *in front*, and dividing the stricture from before backwards.

*Operation from behind.*—This operation is performed as follows. A No. 8 silver catheter is passed down to the stricture ; the patient is then tied up as if for lithotomy ; and the Surgeon, sitting in front, pushes a bistoury with the back turned towards the rectum into the raphe of the perinæum as far as the apex of the prostate, so as, if possible, to open the dilated urethra *behind* the stricture. He then cuts *forwards* through the stricture on to the point of the catheter, and, having thus opened a passage, endeavours to pass that instrument on into the bladder. It is often extremely difficult to find the posterior part of the urethra. When the tissues of the perinæum are hard and gristly, altered by the effusion of plastic matter, and condensed by repeated attacks of inflammation and the existence of fistulæ, it is a most difficult matter to dissect through such an altered mass and hit the urethra beyond it; and the difficulty is still further increased by the bleeding, which is often profuse.

This operation, I have no hesitation in saying, is perhaps the most troublesome in surgery. I have more than once seen the most skilful operators foiled in their endeavours to accomplish it, and compelled to relinquish the operation without concluding it, or only succeed after prolonged and most painful attempts. Fortunately, this operation is now scarcely ever necessary; with patience and under chloroform the Surgeon may almost invariably pass a staff, however small, into the bladder; he then has a sure guide upon which to cut, by following which he must certainly be led through the stricture into the urethra beyond it. In all cases, therefore, urethrotomy should, if practicable, be substituted for the division of the stricture without a guide.

*Operation from front.—Boutonnière Operation.*—The following, which is a modification of the "button-hole" operation, may be advantageously performed in some cases of stricture which are impervious to a grooved staff or other guide, and where it may be thought necessary to divide from without in consequence of their complication with fistula.

The patient having been placed and secured in the lithotomy position, a moderate-sized catheter, No. 8, is passed down to the stricture. The catheter is then turned round, so that its point is made to project into the perinæum just above the stricture. The Surgeon cuts down upon this by an incision about 1½ inch long in the median line, and consequently opens the urethra just above the stricture. The catheter is now withdrawn, and each side of the opened urethra seized with a sharp hook or hook-forceps, and held apart so as to expose the interior of the canal. Oozing having been allowed to cease, the aperture leading through the stricture will now readily enough be found at the lower angle of the opened urethra. A probe or narrow director is slipped into this, and along the guide thus introduced a tenotome is passed, so as to divide the stricture. The catheter is then passed on and tied in the bladder. This operation, though often difficult, is, on the whole, far easier and safer than the other.

## COMPLICATIONS AND RESULTS OF STRICTURE.

RETENTION OF URINE has already been several times described as arising from different causes. Thus, in boys, it arises from the impaction of a calculus in the urethra; in girls it is usually hysterical; in old men it is almost invariably the consequence of atony of the bladder or enlarged prostate, alone or combined. In those of middle age, stricture of the urethra is the occasioning cause in the vast majority of cases. Retention of urine has a tendency to occur in all tight strictures from the gradual and progressive contraction of the canal. It most usually, however, takes place in consequence of a congestive spasmodic condition being superadded to the organic constriction. It commonly happens that a patient having a moderately tight organic stricture commits an excess, or becomes exposed to cold and wet, and thus gets such a congested condition superadded, that the urine will not pass at all, or only in such small quantity by drops, and with so much pain and straining, that the bladder cannot be completely emptied. In these cases the retention always eventually becomes complete; the bladder speedily fills, and rises above the pubes; there is much distress and constitutional disturbance; and, if relief be not afforded, the distended portion of the urethra behind the stricture will ultimately give way, and extravasation of urine ensue. In these circumstances it becomes imperatively necessary to empty the patient's bladder as speedily as possible.

*Treatment.*—This varies with the severity of the symptoms and irritability of the patient. If the retention have not continued very long, and if the patient be not very irritable, an endeavour might be made at once to give relief by passing a small catheter into the bladder. In this the Surgeon may often succeed more readily than might have been expected, the stricture frequently yielding before an instrument more easily when there is retention, than when this condition does not exist. Even if the catheter do not enter the bladder, its point or that of a catgut bougie merely being introduced well into the stricture, it will generally happen, as Brodie has pointed out, that, on the withdrawal of the instrument, the urine will follow in a full stream; but if a sufficiently small catheter be used (in many cases not larger than half of No. 1 is admissible), the instrument may usually be made to fairly enter the bladder. If the patient be very irritable it is better, before attempting the introduction of the instrument, to give him an opiate enema of a drachm of laudanum in about two ounces of starch, and to put him into a warm hip-bath; the introduction of the catheter may now be attempted, and will very generally succeed. Should it still fail, the effect of the inhalation of chloroform should be tried, when it almost invariably may be made to pass without the employment of any great or dangerous degree of force. There are no cases in surgery in which chloroform is of more value than in these; under its influence it is seldom, indeed, that the catheter will not pass. After the instrument has been passed into the bladder it should be left there, being tied in by means of tapes passing from its rings under the patient's thighs, to a bandage that is passed round his waist. Antiphlogistic remedies must then be employed in rather an active manner; a free purge, leeches to the perinæum, if there be tenderness in this region, and salines with antimony. The catheter will be found to be loosened at the end of forty-eight hours, when it should be withdrawn, and the cure by dilatation proceeded with in the usual way.

There are two conditions which in retention of urine may eventually call for operative interference. The first is the necessity of a very frequent introduction of the catheter, owing to an irritable state of the bladder. In these cases, it may eventually be thought safer to puncture the bladder and to establish a direct opening, either through the rectum or above the pubes, rather than subject the patient to the constant terror of repeated catheterisms, which will end by exhausting him. Every act of catheterism inflicts a certain shock to the system, greater in some, less in others; and if this have to be repeated every three or four hours, less danger will probably result from puncture of the bladder than from the frequent repetitions of the use of the instrument, especially as in these cases the patient cannot allow it to be tied in for the same reason, that of extreme irritability, that necessitates its repeated introduction.

The second condition that calls for operation is a different one, viz., the necessity of relieving retention of urine. For if the Surgeon be unable to introduce a catheter in the ordinary way through the stricture, relief must be given to the over-distended bladder in some other way, lest it or the urethra burst, and extravasation of urine occur. The bladder may be emptied in four ways : 1, by Forcible Catheterism ; 2, by making an Opening into the Urethra behind and through the Stricture ; 3, by Puncturing the Viscus itself through the Rectum ; and 4, by Puncturing it above the Pubes, and 5, by Aspiration.

1. **Forcible Catheterism** is a most unsurgical and dangerous procedure. Nothing can surely be more improper than to take a small, stiff, silver catheter, pass it down to the stricture, and then, by main force, attempt to drive it on into the bladder. In these cases the Surgeon usually fails in his attempt at reaching the viscus, but pushes the point of the instrument into the tissues around the neck of the bladder or into the prostate, and thus induces great, and perhaps even fatal, mischief in these regions. If he should, by some fortunate accident, reach the bladder, it is not by any skilful though forcible expansion of the stricture, but rather by perforating the urethra, and burrowing through the corpus spongiosum and prostate—"tunnelling," as it has been termed—until he again enter that canal, or in some such way reach the neck of the bladder.

2. **Opening the Urethra behind and through the Stricture.**—In the kind of retention of urine that we are now discussing, the safest, though by no means the easiest mode of affording relief after the failure of the catheter, is to make an incision into the middle line of the perinæum, and to open the urethra behind or through the stricture. In doing this there is much less difficulty in cases of retention, than when the bladder is empty. In consequence of the urethra being distended by the accumulation of urine, and by the straining of the patient, it sometimes attains a considerable magnitude ; though, if this be not the case, the operation may prove a very serious and difficult one. The operation, which is essentially the same as that for impermeable stricture, described at p. 911, is performed by passing a catheter down to the stricture ; opening the distended sinus of the urethra *beyond* this ; cutting upwards through the stricture upon the end of the instrument ; and then passing the instrument on into the bladder, or allowing the urine to flow from the aperture thus made in the perinæum. In doing this, care must be taken to keep strictly in the direction of the mesial line, so as not to wound vessels of importance. One advantage of this operation is, that the stricture may by it be cured at the same time that the retention is relieved ; and, as the incisions do not extend into the bladder, but are limited to the urethra, there is less danger to the patient than when that viscus is opened.

Another advantage of the perineal incision in these cases is, that it not unfrequently happens that urinary abscess has begun to form, or the extravasation of a few drops of urine has taken place sooner than the Surgeon may have had any idea of : and if so, the incision through the perinæum will afford an exit for any extravasated matters, at the same time that it relieves the patient from the distress and danger of the retention. Should any mischief of this kind have taken place, it is not necessary to be so particular about opening the urethra with the knife ; for, an aperture having already been established in it, the urine will readily flow through the artificial channel thus formed by free incision into the inflamed or suppurating perinæum.

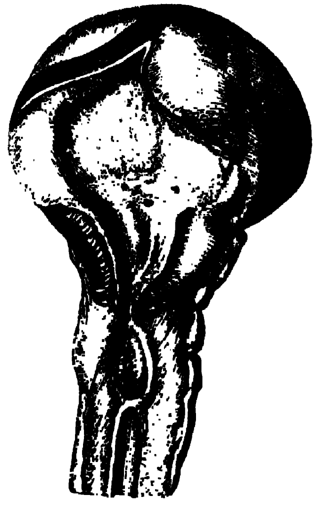


Fig. 814. — Seat of Puncture through Rectum in a case of Stricture.

3. **Puncture of the Bladder through the Rectum.**—After emptying the bowel by means of an enema, the Surgeon passes the left index-finger well into the gut, feeling for the posterior margin of the prostate; he then carries the trochar and cannula, which are long and somewhat curved, upon this as a guide, and, when the extremity of the instrument has reached the posterior edge of the prostate, he pushes it upwards into the bladder (Fig. 794). The seat of the puncture between but in front of the ureters is well shown in Fig. 814, which represents the bladder and strictured urethra of a man who died some days after this operation had been performed for retention from stricture. In performing this operation, the Surgeon perforates the bladder in that portion of its fundus which is uncovered by peritoneum, being bounded behind by the reflection of the serous membrane, anteriorly by the prostate, and on each side by the vesiculæ seminales. In order to avoid wounding any of these structures, he should keep strictly in the mesial line, and puncture immediately behind the prostate. In introducing the instrument into the rectum, the Surgeon should withdraw the point of the stylet into the cannula, so as to avoid wounding the gut, and not push it forwards until he has the end of the cannula fixed against the spot where he intends to make the perforation. After withdrawing the stylet and emptying the bladder, the cannula should be tied in by means of tapes. It is often difficult to prevent the cannula from slipping out of the wound when only tied in, and thus exposing the patient to the danger of urinary infiltration. It may be securely retained by means of a stitch of silver wire passed on either side through the slit in the guard and the contiguous skin of the nates. The cannula should be retained for a few days until urine begins to pass by the urethra, or until a catheter has been passed through the stricture, when it must be withdrawn and the aperture left to close. In consequence of the irritation of the urine being removed from the urethra, a catheter may often be passed a few days after the operation; and the stricture will readily yield to dilatation in the ordinary way.

This operation has the advantage of being far easier of performance than the last, and may doubtless occasionally be required in those very rare cases of retention from stricture in which there is no sign of abscess or extravasation in the perinæum, in which the urethra appears not to be dilated behind the stricture, in which the prostate is not enlarged, and in which, under chloroform, and with patience, a catheter cannot be passed into the bladder; a combination of circumstances that will but very rarely indeed occur to a Surgeon skilled in the use of his instruments.

The operation of puncture through the rectum is not devoid of danger; peritonitis, urinary infiltration, and pelvic inflammation and abscess, may result from it.

The recto-vesical pouch of the peritoneum will sometimes descend so abnormally low as to cover the *bas fond* of the bladder as far as the prostate, leaving no space for a puncture to be safely made. This condition necessarily cannot be determined during life, hence its great danger. I have known two instances in which a double puncture was in this way made through the fold of the recto-vesical pouch, half an inch beyond an unenlarged prostate, for relief of retention. In both cases, death from peritonitis occurred. The preparations are in University College Museum.

In a remarkable case that was under my care at the Hospital (in 1859), a sequence occurred which I have never seen noticed; viz., the diffusion of rectal flatus through the areolar tissue of the pelvis and down the thighs and nates, producing an emphysematous condition of these parts and the death of the patient. The case was briefly as follows. A middle-aged man had suffered from traumatic stricture for very many years—indeed, from childhood. He was admitted with retention. As no catheter ever had been or could be passed, I punctured the bladder by the rectum in the usual way. The cannula was removed on the fifth day. He then passed urine *per urethram*, and continued to do so up to the time of his death. The day after the withdrawal of the cannula he felt very ill, but without any positive or tangible complaint. The next day it was found that the back and inner part of both thighs were emphysematous and crackling, evidently distended with air. The emphysema extended downwards and also up the flanks, and appeared even in the right arm. There was no pain or discoloration. He died on the following day, the eighth after the puncture. After death no trace of pelvic inflammation, suppuration, or urinary extravasation was found; but there was much infiltration of gas under the pelvic peritoneum, and in the areolar tissue between the bladder and rectum. The gas had probably passed through the sciatic notches into the posterior parts of the thighs. It was fetid, like intestinal flatus.

4. **Puncture of the Bladder above the Pubes,** in cases of retention from stricture, is but seldom resorted to; although some Surgeons of eminence, more especially Paget of Leicester, have strongly recommended and often practised it. This operation, which has been discussed at p. 868, is undoubtedly easy of performance, and sufficiently safe, though not devoid of the danger of infiltration of urine into the tissues around the puncture, and of the inconvenience of a fistulous opening being left. There is one class of cases to which it appears to be especially applicable, and in which I have had occasion to practise it; viz., those cases of retention from impassable stricture, in which there co-exists an enlargement of the prostate, rendering puncture through the rectum impossible, the Surgeon's finger not being able to reach beyond the enlarged prostate; and here undoubtedly the safest, if not the only course to pursue, is the suprapubic puncture.

5. **The Employment of the Aspirator** for the purpose of emptying an over-distended bladder is, however, upon the whole the simplest method of treatment, and should be preferred to any of the preceding plans, in the first instance at all events. The perforating trochar of the aspirator should be passed directly into the bladder above the pubes. The operation is a simple one, and with a little care is perfectly safe. The chief point is not to thrust the

perforator too deeply, and gently to withdraw it before the whole of the urine has escaped, so as to prevent the emptied bladder from collapsing upon and being wounded by its point (see pp. 570, 571).

After the bladder has been punctured, by whichever of these methods the Surgeon may think proper to adopt, means must be taken to restore the calibre of the urethra, so as to prevent the orifice of the puncture from degenerating into a permanent fistulous opening. With this view the cannula should be left in the bladder, and the urine allowed to discharge through it for from four to six days. At the expiration of this time, should no urine have passed by the urethra, the stricture in the canal will be found to be relaxed, and a small instrument may usually without much difficulty be introduced into the bladder, where it should be retained, the cannula being withdrawn. The cure of the stricture by dilatation may then be proceeded with in the usual way.

In connection with this subject, it may be stated that *Puncture of the Bladder* may be required for the following conditions :—

1. Impermeable stricture (through rectum).
2. Complete rupture of urethra (through rectum).
3. Enlarged prostate (above pubes).

Extravasation of Urine is one of the most dangerous and fatal results of unrelieved retention. This serious accident most commonly occurs in consequence of that portion of the urethra which is immediately behind the stricture becoming over-distended, so that it may be thinned ; and a fissure then forming in it, a few drops of urine escape into the surrounding areolar tissue. Some sloughing immediately ensues, the narrow aperture made in the urethra becomes enlarged, and the urine is then driven with the whole force of the contraction of the over-distended bladder into the areolar tissue of the perinæum, scrotum, and groin.

In other cases, a lacuna in the urethra inflames, an urinary abscess forms, and the urine being driven into this, the cyst gives way, and general extravasation occurs.

The part of the urethra that gives way is almost invariably the membranous portion of the canal, just between the layers of the triangular ligament, where it is weak, being least supported by surrounding structures, and usually most dilated and attenuated by the pressure to which it has been subjected. The extravasated urine afterwards finds its way through the anterior layer of the triangular ligament, where it is perforated by the urethra, and so beneath the deep layer of the superficial fascia of the perinæum, by which its course is afterwards directed. This fascia is firmly attached across the perinæum to the free border of the triangular ligament and, along each side, to the rami of the ischium and pubes, as far upwards as the pubic spine, from which point its attachments are continued outwards along Poupart's ligament to the crest of the ilium. The extravasated urine, therefore, uniformly takes a course forward into the perinæum and scrotum, and upwards upon the external organs of generation, the groins, and the anterior abdominal wall : so that it ascends contrary to its gravity rather than soaks back into the more dependent parts of the body, as it would do, were it not for the particular connection of the fasciæ that has just been alluded to. I have, however, known the superficial fascia to give way, and the urine, then gravitating backward, to give rise to extensive sloughing in the ischio-rectal fossæ and about the nates, denuding the rectum.

**Local Effects of Extravasated Urine.**—The effects of urine that has become acrid, decomposed, and concentrated by long retention, are most deleterious upon those tissues with which it comes into contact. It acts as an irritant poison on all that it touches. The vitality of whatever portion of areolar tissue it infiltrates is immediately destroyed ; the tissue becoming converted into a kind of putrid stringy slough, intermixed with and soddened by a quantity of fetid dark-coloured acrid pus and urine. The ravages of extravasated urine are often extensive ; the urethra giving way suddenly behind the stricture, the fluid is driven with all the force of the vital and physical contractility of the over-distended bladder into the perinæum, and thence rapidly finds its way through the scrotum upwards. In other cases, again, the extravasation occurs more slowly ; a few drops appear first of all to escape from the urethra through a small rent or ulcer in it ; these give rise to inflammation in the surrounding structures, by which the progress of the extravasation is for a time limited. It is especially upon the areolar tissue of the scrotum that the effects of the extravasation manifest themselves in their full intensity, causing great distension and rapid sloughing of it. The skin speedily participates in this action, becoming of a dusky-red or purple colour, and then falling into a state of gangrene. In this way the testes may become denuded, and the cords exposed. It is remarkable, however, if the patient survive these destructive effects, with what rapidity reparative action goes on in this region. It is seldom that infiltration extends higher than the groins, or the anterior portion of the abdominal wall ; but it may reach the costal cartilages before proving fatal.

When the extravasation is deep, the urethra being opened between the layers of the triangular ligament, the patient, after suffering from retention, experiences a sensation of relief, as if he were emptying his bladder, and as if something had given way in the perinæum, followed after a time by a hot, burning, and throbbing pain. There may be but little swelling for a day or two, but then a doughy red diffused intumescence takes place in the scrotum and rapidly extends forwards. When the rupture is altogether anterior to the deep perineal fascia, then rapid swelling and infiltration, partly urinous, partly inflammatory, take place in the scrotum and penis ; these parts become enormously distended, œdematous, crackling, and emphysematous, with the local signs that have already been mentioned.

The *Constitutional Disturbance* is always considerable ; at first it is of an irritative type, but is speedily followed by asthenic and typhoid symptoms, by which the patient is at last carried off.

The *Treatment* consists in making a free and ready outlet for the urine as early as possible. This should be done, as soon as the extravasation is known to have occurred, by a deep incision into the middle of the perinæum. So soon as any pain and throbbing, with diffused swelling, occur in the perinæum, with redness and more or less œdema of the scrotum, the patient should be drawn to the end of the bed and placed in the position for lithotomy. The Surgeon should next introduce his left index-finger into the rectum, so that the gut may not be wounded, and then pushing a long sharp-pointed bistoury deeply in the raphe of the perinæum, cut upward to a sufficient extent into the extravasation, and in the direction of the urethra. A catheter should then, if possible, be introduced, secured in the bladder, and left unplugged, with an India-rubber tube attached ; in this way no further effusion can occur, an outlet will be afforded to matters already effused, and the greater part of the urine will commonly be found to escape after a time by the aperture thus made. Should the case not be seen until extravasation has spread widely, a free incision should not only be made into the perinæum, extending to the aperture in the urethra, but also into the scrotum on each side of the septum, into the penis, and wherever else swelling is observed. The sole chance of safety for the patient lies in making these free incisions, through which the parts may, to a certain extent, empty themselves. However extensive the infiltration and serious the mischief may be, we need not despair of the patient if a free outlet can be obtained for the acrid and putrescent urine and effused matters ; and in order to secure this, the infiltration must be followed by incisions as high as it extends. The parts must, at the same time, be covered with chlorinated and yeast poultices ; and the constitutional powers of the patient must be supported by good nourishment and a sufficient supply of stimulants.

If the patient survive the immediate impression upon the system produced by the gangrene and the urinary infiltration, he must be prepared to go through a severe trial to his constitutional powers, in the separation of the sloughs, the profuse discharge, and other sources of irritation that are set up. During this period he will require abundant support ; the brandy-and-egg mixture, ammonia and bark, with any nourishment that he can take ; and much attention should be paid to the removal of the sloughs, to giving a ready outlet to the discharges, and to keeping the patient as clean and as free from all local irritation as possible.

**Urinary Abscess** may be considered in many cases as a limited effusion of urine mixed with pus, and circumscribed by plastic matter that is deposited in the tissues with which the urine comes into contact. It is generally occasioned by the irritation of the passage of instruments, but may arise simply as the effect of stricture, or from inflammation of some of the urethral follicles. From some cause of this kind a small abrasion or aperture forms in the urethra, a drop or two of urine escapes into the subcutaneous areolar tissue, and this becomes bounded or circumscribed by plastic deposit around it, so that extravasation does not occur. Such an abscess as this may form at any part of the urethra ; but it is most frequently met with in the perinæum, appearing to take its origin from the bulb or membranous part. It is rarely dangerous, but is chiefly of consequence by being commonly followed by urinary fistula. The extent and the amount of mischief done by an urinary abscess will greatly depend on the side of the urethra on which it is situated. When, as usually happens, it forms at the lower surface of the canal, it readily comes forward without much or extensive burrowing. But when situated on the upper wall of the urethra (which, however, is very rare,) or at the upper part of the side of the canal, it may burrow widely before it points or is discharged externally, occasioning great induration, infiltration, and mischief in neighbouring parts.

*Symptoms.*—An urinary abscess is indicated by the formation of a small, somewhat circumscribed, hard, and painful tumour, situated in the neighbourhood of the urethra. It is usually unattended by constitutional disturbance; unless it attain any considerable bulk, when some pyrexia may ensue. It is principally in the perinæum that it attains any degree of magnitude, then constituting a perineal abscess, characterised by a deeply seated, hard, tense tumour, brawny and without fluctuation; attended by considerable weight and throbbing in this region. It does not readily point, owing to the manner in which it is bound down by the superficial fascia.

*Treatment.*—Early incision is required. When the abscess occurs in the scrotum or anterior to it the Surgeon should wait for fluctuation; but when it is seated in the perinæum, he need not do so, but should at once make a free incision through the mesial line into the hard brawny mass, in order to prevent the certainty of extravasation of urine. After the opening has been made, fomentations and poultices should be used.

**Urinary Fistulæ** commonly form in the perinæum and scrotum, as the result of abscess in these regions communicating with the urethra; occasionally, however, they are met with in other situations, as in the groin, the anterior abdominal wall, or the inside of the thigh. They usually communicate with the bulb or with the membranous portion of the urethra, but occasionally occur anterior to this. In number they vary considerably; when occurring in the scrotal and penile portions of the urethra, they are usually single; but when in the perineal, they are often rather numerous; several apertures being occasionally met with about the perinæum, scrotum, and nates. In one case Civiale found as many as fifty-two. Their size also differs considerably; some only admitting the finest probe, whilst others are large cloacæ. In a case under my care, the patient had a tunnel of this kind in the groin that would readily admit three fingers. They are usually tortuous, elongated, and narrow; sometimes constricted externally and more widely dilated behind. The surrounding parts are greatly condensed; the whole of the scrotum and penis is enormously enlarged, indurated, and almost cartilaginous in structure. The urine may escape almost entirely through the fistulæ, scarcely any being discharged through the urethral orifice; or there may be but a slight exudation from the fistulous openings.

The *Treatment* of urinary fistula varies according as it is complicated with stricture, and as it is situated in the anterior or the posterior part of the canal.

If there be a stricture, this, as the cause of the fistula, will require removal either by dilatation or by the perineal section. If the stricture be not very tight and hard, dilatation commonly succeeds; the instrument being introduced every second or third day, until the urethra is dilated to its normal size, when the fistulous tracks will in many cases close. In some instances, however, the frequent introduction and withdrawal of the catheter is a source of irritation, and then it had better be left in. When this practice is adopted, a moderate-sized elastic catheter should be used. If this be too small, the urine will flow between it and the sides of the urethra, and thus escape through the fistulæ; if too large, it stretches the urethral orifice of the fistula injuriously.

If the stricture be very tough and irritable, the better plan is to perform urethrotomy at once, as much time and pain are thus saved. In the majority of instances, internal urethrotomy with Civiale's instrument appears to me to be the safest and simplest procedure, and I have very advantageously practised it in such cases. But if the fistulæ be very numerous, so as to riddle the perinæum and scrotum in all directions, perhaps the better plan is to perform the perineal section. In this way we not only divide the stricture, and thus at once remove all obstruction, but give a free exit to the urine, which, instead of escaping by tortuous and sinuous passages, finds its way out readily through the new aperture that has been made, which will eventually granulate and heal by the second intention.

The fistulæ, especially if small and recent, will sometimes heal kindly enough after the removal of the obstruction ; but if extensive, old, and cartilaginous, they are of course little disposed to take on reparative action ; and although the cause that in the first instance gave rise to them may be removed, yet they constitute an independent affection which requires special treatment.

The special treatment for urinary fistula must vary according to the size of the canal, but more particularly with regard to the part of the urethra with which it communicates ; whether it be a *Perineal*, a *Scrotal*, or a *Penile* fistula. But in all cases, and wherever it be situated, there is one most important point to be attended to, viz., never to let the fistula be disturbed or irritated by the passage of urine over or through it, or it will never heal. Hence the urine must always be drawn off with the catheter, which the patient should be taught to pass for himself.

If the fistula be *Perineal*, and of small size, a probe coated with melted nitrate of silver, or a wire made red-hot in the ordinary way, or by the galvanic current, and passed down it occasionally, may cause its contraction. If it be large, a gum-catheter should be kept in the bladder, and the edges of the fistula freely rubbed with the nitrate of silver, or deeply pared and brought together by quilled sutures. If the fistulæ be large and very numerous, it will be better to pass a grooved director down the principal ones, and slit them up so as to throw the several sinuses into the larger one.

When the fistula is *Scrotal*, it often requires to be laid open, and to be made to granulate from the bottom, when it may be found to communicate with large sloughy and ill-conditioned cavities in this situation.

When *Penile*, the fistula is usually much more troublesome to heal ; its edges are thin, and the track is short and shallow.

**Urethroplasty** may in such cases be advantageously practised. Operations of this kind require for their success very careful management and minute attention to detail ; they very commonly fail in consequence of a small quantity of urine or of mucus escaping through the wound, and thus interfering with union of its lips.

In order to prevent this accident, which is fatal to the success of the operation, the patient should be taught to pass a catheter, and thus to draw off his own urine after the operation as often as necessary ; or an assistant must do this every third or fourth hour. Should this, however, not be practicable, a full-sized gum-catheter should be passed into the bladder and properly secured there. It should be left without a plug, so that no distension of the bladder and consequent likelihood of escape of urine between the urethra and the instrument may take place. In order to prevent urinous effusion over the integuments of the penis and scrotum, a vulcanised India-rubber tube should be attached to the end of the catheter, by which means the flow of the urine is directed away from the patient.

Urethroplastic operations may be varied according to the seat and extent of the fistulous opening.

If the fistula be in the *perinæum*, the parts around being thickened and indurated, its closure may often be attained by freely and deeply paring the edges, and then bringing them together with the quilled suture, or by Sims's button.

When the fistula is *scrotal*, the edges should be freely pared, and the parts around widely dissected up so as to form large and thick flaps of cellulo-cutaneous tissue, which may be brought and held together by metallic sutures or shotted clamps. In this way, if union be not obtained throughout the whole length of the fistula, it may be to a partial extent; and, after a time, a second or a third operation will complete the cure.

When the fistula is *penile*, the difficulties in effecting closure become immensely increased. This is owing to the thinness of the integumental structures and the absence of subcutaneous areolar tissue in this region, so that there is not sufficient thickness of the parts for ready plastic union. In these cases, the Surgeon has a choice of four operations.

1. Nélaton has recommended the following procedure. The edges of the fistula having been pared, the skin around, to the extent of about an inch, should be dissected up subcutaneously through an opening made below the fistula, the edges of which must then be brought together by a few points of suture. The displacement of the skin covers in the aperture in the urethra and causes granulations to spring up, by which the fistula is closed (Fig. 815).

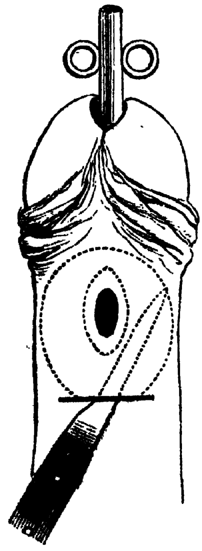


Fig. 815.—Urethroplasty. Nélaton's Operation: First Method.

2. The edges of the fistula having been pared and the skin separated widely, lateral incisions may be made so as to take off all tension, and a slip of India-rubber may then be passed underneath the flaps of skin, in order to prevent contact of the urine from disturbing the adhesions (Fig. 816).

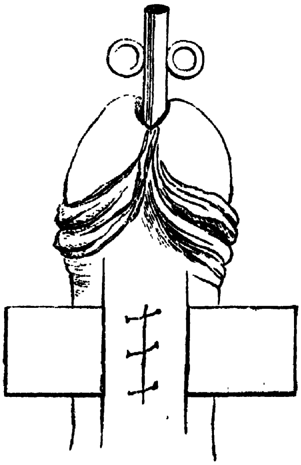


Fig. 816.—Urethroplasty. Nélaton's Operation: Second Method.

3. Ricord, recognising the fact that the occasional intrusion of a drop of urine between the freshened edges of the integuments brought together to close the fistula has been the most common cause of disunion, has recommended that, in those cases in which a perineal or a scrotal fistula happens to co-exist

with a penile one, a catheter should be passed through the former into the bladder, and left there during the whole of the operative procedures that are adopted for the closure of the penile fistula. Should no fistula exist in the perinæum, he has proposed, though I believe the operation has never yet been practised, to puncture the bladder—which would most conveniently and safely be done through the rectum—and to keep it emptied in this way until the penile fistula has been closed by one of the preceding operations, and then to allow the lower aperture to close spontaneously; or, if it were situated in the perinæum, to adopt surgical means for its occlusion.

4. Le Gros Clark has recommended and successfully practised the following operation. Having pared the edges of the fistula, he makes a transverse cut through the integuments of the penis, about an inch in length, above and below it. He then dissects up the flaps of skin so bounded, and brings them together by means of clamps or the quilled suture. By this operation a wide raw surface from each side is brought into contact, instead of a mere raw edge of cut integument, and there is consequently a greater chance of successful union resulting (Figs 817, 818).

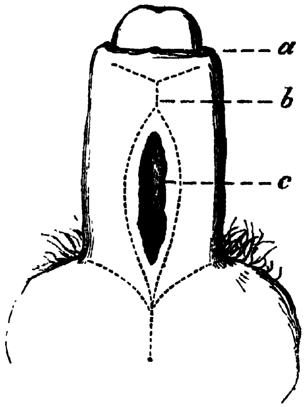


Fig. 817. -Urethroplasty. Clark's Operation : First Stage.

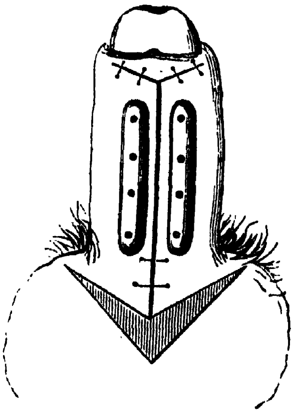


Fig. 818.—Urethroplasty. Clark's Operation : Second Stage.

**Death after Operations on the Urinary Organs.**—As has already been stated in the preceding chapters, that condition which more than any other influences the result of operation on the urinary organs is the state of the kidneys. If these be sound, recovery, even after the most severe operations, is the rule. Hence in a great measure, doubtless, the low rate of mortality after lithotomy in children. If the kidneys be diseased, the most trivial operation, the introduction of a lithotrite or the passage of a catheter, may lead to a fatal result. When death occurs in lithotrity in cases of unrelieved stone, chronic prostate disease, or during the treatment of a stricture, it most frequently is caused by suppurative inflammation of the kidneys.

**Stricture of the Female Urethra** is rare. When it occurs, it is seated at the external orifice, which will be found to be narrowed and sharp-edged. There is often some thickening of the corpus spongiosum. The disease is always, I believe, the result of gonorrhœa. The symptoms are the ordinary one of irritability of the bladder, frequent desire to micturate, and some difficulty or delay in doing so.

The *Treatment* consists in the dilatation of the orifice by means of a two-bladed dilator (Fig. 806).

### URINARY VAGINAL FISTULÆ.

Preternatural communications between the urinary passages and the vagina commonly arise from injurious pressure upon and consequent sloughing of the anterior wall of this canal, to a greater or less extent, during parturition. They may, however, occur from idiopathic abscess, or from malignant disease involving those parts.

VARIETIES.—Urinary vaginal fistulæ are essentially of two kinds, according as the communication is established between the urethra or the fundus of the bladder and the vagina. Hence they may be divided into *Urethral* and *Vesical.*

**Urethro-Vaginal Fistulæ** are, so far as my observation goes, of most common occurrence ; and this is readily explained by the fact that the urethra passes along the anterior aspect of the vagina for some distance before it terminates in the bladder, and occupies that portion of the vaginal wall which is most likely to be compressed, during labour, under the arch of the pubes. These fistulæ are usually of small size and linear. **Vesico-vaginal Fistulæ** establish a communication between the neck or fundus of the bladder and the vagina. They are consequently situated further back than the other, and are usually larger and more ragged.

RESULTS.—The existence of a urinary fistula in the vagina is always a source of serious discomfort and distress to the patient. The dribbling of urine through the preternatural aperture is generally continuous ; although, if this be situated far back behind the orifices of the ureters, it may be somewhat intermittent, a flow taking place as the lower portion of the bladder fills. The incontinence of urine thus produced gives rise to irritation and excoriation about the external parts, and occasions a strong ammoniacal odour to hang about the patient.

The precise seat and extent of the fistulous opening are best ascertained by placing the patient on her knees opposite a good light, and holding aside the posterior and lateral walls of the vagina with bent spatulæ ; when the anterior aspect of that canal will have a tendency to protrude, and thus to expose the fistula, at the same time that the introduction of a bent probe, or of a female catheter, into the urethra, will guide the Surgeon to the artificial opening in the urinary passage.

TREATMENT.—The cure of a vaginal fistula can only be accomplished by causing a coalescence of its sides. When it is small, about a line or two in diameter, and more especially if urethral, this may best be effected by touching the edges of the aperture with the galvanic cautery or a red-hot wire, and repeating this application once a fortnight or three weeks, until a cure is effected by their gradual contraction. This little operation is most conveniently effected by placing the patient in a kneeling posture, and then holding aside the posterior and lateral vaginal walls by means of curved copper spatulæ, when the opening will be fairly brought into view.

When the fistula is larger, and especially when vesical, its cure can only be accomplished by paring the edges, and bringing them together with sutures, and thus attempting to procure union by the first intention. In effecting this, however, two difficulties present themselves—the sutures either cutting their way out too soon, or the trickling of urine between the freshly pared edges interfering with adhesion. In order to overcome these difficulties, a variety of ingenious contrivances have been introduced by different Surgeons; amongst which may be especially mentioned the clamps of Marion Sims and Baker Brown, and the button-suture of Bozeman. To Sims especially is due the great merit of having substituted silver wires for silk sutures in this operation, by which the probabilities of a successful result have been very greatly increased.

Before the operation, the bowels should have been freely opened by castor-oil and an enema. No chloroform should be given, as its administration interferes with the position that the patient must maintain during the operation. This should be on the knees and elbows, on a narrow table, with the buttocks well raised and the head low. It is of great moment that the parts should be freely exposed. This is best done by means of the "duck-billed" speculum (Fig. 819), by which the posterior wall of the vagina is well drawn up and out of the way of the operator, and light is reflected on the fistulous opening. The edges of the aperture are now to be freely pared. This is best done by seizing them with a hook-forceps or a double hook, and dissecting off the vaginal mucous membrane to the extent of about a quarter of an inch all round, by means of a fine small scalpel or angularly set knives (Figs. 820, 821) and scissors properly curved. The dissection should be carried towards the fissure, and especial care taken that the angles are well cleared of mucous membrane.

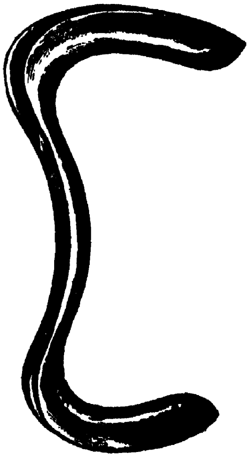
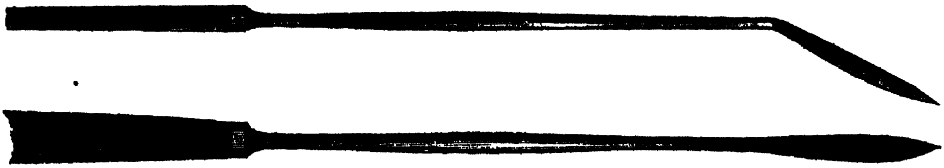


Fig. 819.—Duck-billed Speculum.

After the edges of the fistula have been freely pared, and all bridles or cicatricial constrictions divided, sutures of silver or annealed iron wire (which does not rust) are passed across the lips of the wound. These wires may most conveniently be passed by means of the hollow needle (Fig. 822); or, if this be not at hand, a silk thread may be passed by a nævus or cork-screw needle, a full half inch from the freshened edge of the fistula, and brought out through a corresponding point on the other side of the fistula, without having transfixed the mucous membrane of the bladder. As many threads as necessary having been passed in this way, a piece of silver wire about eighteen inches long is attached to the silk, which is then drawn out, leaving the wire to occupy its place, so that its centre corresponds to the fissure, and both ends hang out of


Figs. 820 and 821.—Angularly Curved Knives.

the vagina. Sims then passes the uppermost free ends through holes made in a narrow leaden bar, on which they are clamped, by having split shot fixed upon them in the same way as is done on a fishing line. The unclamped wires are now drawn down until the bar is pulled close to the upper suture holes; and a second clamp is then fixed to these ends and is pushed up against the lower suture apertures. In this way the edges of the fistula are brought and held together on each side by a clamp, which may be allowed to remain in from seven to ten days. The clamps may then be removed by clipping off the flattened shots from the anterior one, which is thus detached from its bed. The posterior one, with the wires attached, may then be hooked up, pushed backwards, and lifted out of the vagina with forceps. Instead of a clamp, Simpson used a splint made of annealed iron wire, which surrounds and supports the tissues around the fistula. In many cases, however, where the fistula is of but moderate size, the clamp and splint may be dispensed with, and the edges of the opening brought together with the suture wires only.

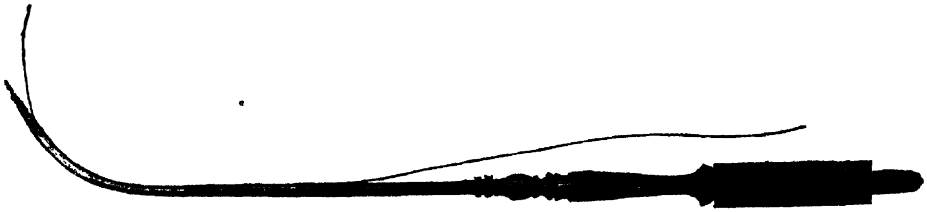


Fig. 822.—Hollow Suture Needle.

In the after-treatment, especial attention is required: and here the great point is to prevent the contact of the urine with the edges of the fistula. With this view a catheter should be introduced, and worn in the bladder, so that no urine may collect in this organ. For this purpose, Sims has invented a very ingenious catheter, represented in the annexed cut (Fig. 823), which may be worn with more comfort, and with less chance of slipping, than the ordinary instrument. After the patient has been put to bed, and the catheter introduced, a full opiate should be given, and continued throughout the treatment, with a view of preventing the action of the bowels, a point on which Sims lays much stress, and to which the success of his operations may be in a great measure attributed. It is very seldom that they require to be opened for ten or fifteen days, provided the patient be kept on a rigid diet. During this treatment the catheter may be removed once or twice a day, in order to be cleansed and to be kept free from phosphatic or mucous accumulations; and free ablutions of the external genitals by sponge or syringe and warm water should be practised during the whole of the treatment. After the removal of the sutures, Sims advises that the catheter should be continued, and great care taken that the patient do not move too soon, lest the weak cicatrix be strained.

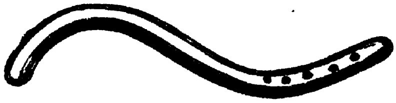
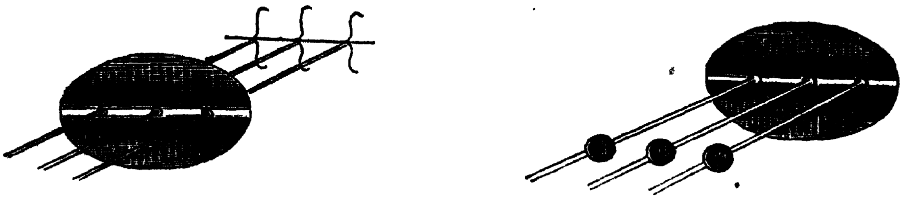


Fig. 823.—Sims's Catheter.

A very simple and successful mode of closing these fistulæ has been invented by Bozeman, by what he terms the "button-suture." After paring the edges of the fistula, and passing silver wires across in the usual way, he draws the parts together by passing both ends of the wire through an aperture in a steel rod, which being carried along them closes the opening. A thin leaden plate, "the button," properly perforated down the middle, is then slipped along the wires so as to cover the fistula (Fig. 824); and split shot having been pushed along, their free extremities are pressed tightly against the button, the wires are then properly nipped, and the apparatus left on for about ten days (Fig. 824); the shot are then cut off, the leaden plate is carefully lifted off, and the suture wires, having been straightened out, are withdrawn.



Bozeman's Apparatus for Button Suture.

Fig. 824.—Application of Plate. Fig. 825.—Application of split shot.

Whatever kind of suture may be employed, it is always of great importance that the edges of the fistula be brought together *transversely* to the long axis of the vagina. Should the abnormal aperture be close to, or even implicate, the cervix uteri, this part may be drawn down and transfixed with the sutures, thus adding materially to the support of the posterior lip of the fissure.

### TUMOURS IN THE URETHRA.

Small **Polypoid Tumours** are not unfrequently met with inside the urethral orifice. They have occasionally a gonorrhœal origin, though they commonly arise irrespectively of such disease. They are always very vascular, and are most frequently met with in or around the female urethra, where they are of a bright red colour, have a florid hue, bleed freely when touched, and are composed of a spongy kind of erectile tissue; they are commonly conoidal or oval, encircling the urethral orifice on one side, or even forming a complete zone around it. They grow slowly, and seldom attain a larger size than that of a raspberry. They are not unfrequently accompanied by a vast deal of sympathetic irritation, great pain in micturition, attended by an admixture of mucus or pus in the urine, uneasiness of the lower part of the abdomen, and often aching in the loins.

These vascular tumours are far less frequent in the male than in the female urethra. When they occur in men, they usually constitute a small granular florid mass inside the orifice of the canal.

When seated in or around the female urethra, these tumours not unfrequently give rise to very great and continuous irritation; much pain during and after passing urine, radiating through the whole pelvic region, and, in fact, many of the symptoms of stone; so that patients labouring under this affection are often sounded on the supposition of the existence of calculus.

TREATMENT.—Vascular urethral tumours may be removed in four ways:—by Excision, Ligature, Caustics, or the Actual Cautery.

1. *Excision.* When situated within the male urethra, the tumours should be snipped off by a fine pair of curved scissors. When situated in or around the female urethra, if of small size and pedunculated, they may readily enough be removed by the scissors or dissected away; the canal of the urethra being encroached on as little as possible. This operation is, however, always attended or followed by very considerable and continuous arterial hæmorrhage, which has even, in some instances, been fatal. Hence, when the tumour is large, and the patient weakly, excision should be practised with much caution. If it be done, the hæmorrhage may be arrested by the introduction of a catheter into the urethra, and by firm pressure on the bleeding surface by means of a pad of lint, supported by a T-bandage.

2. *Ligature* is not a convenient mode of removing these growths; its application is difficult, very painful, and tedious.

3. *Caustics,* particularly strong nitric acid or potassa cum calce, may be very conveniently employed where the tumour is of small size and very vascular. In applying them, the upper wall of the canal must be protected by a broad director introduced along it.

4. The *Actual* or *Galvanic Cautery* is the most convenient agent for the removal of vascular tumours from the *female* urethra. By it they are at once destroyed without hæmorrhage; and the eschar that is formed protects the subjacent raw surface from the irritation of the urine. If they be situated deeply within the urethra, and of small size, the galvanic cautery or a red-hot wire will most easily reach them; but if they be at or around the orifice, I employ a small olive-shaped cautery. During its application, the surrounding parts may be protected from the action of heat by a wooden spoon having a hole cut in the middle through which the application is made, and the upper wall of the urethra by a director or silver catheter, which should be retained after the operation.

# CHAPTER LXXIII.

## DISEASES OF THE PENIS AND SCROTUM.

### DISEASES OF THE PENIS.

CONGENITAL MALFORMATIONS.—**Adhesion of Penis to Scrotum.** I have once, and once only, met with a very curious malformation of the genital organs, the penis being tied down by its under surface to the scrotum, so as to lie in a deep sulcus between the testes. In this case the raphé of the scrotum appeared to be continued in a narrow rather firm band upwards to the under surface of the penis, so that this organ was always bent or bowed downwards. The patient, a man of 30, passed his urine downwards, apparently from the under surface of the scrotum; when erection took place, the penis curved up in a semicircular form, the convexity upwards, the glans penis being tightly tied down to the scrotum by the narrow tense band continued up from the raphé. In fact, the condition of this organ was very like that which is met with in the tongue when "tongue-tied." This malformation was remedied by cutting through the frænum which tied the penis down, and thus liberating the organ.

**Hypospadias.**—It occasionally happens that there is an arrest of union in the mesial line of the penis, so that a slit or fissure is left communicating with the urethra. This gap commonly occurs on the under surface of the organ, constituting *hypospadias*, and is confined to the glans and upper part of the penis; though it occasionally extends backwards to the root of the organ, and may then be associated with some of those kinds of malformation that are erroneously considered as examples of hermaphroditism. These conditions are mostly incurable, though plastic proceedings have occasionally been devised and practised for their relief.

**Absence of Corpus Spongiosum and Urethra.**—In some cases the urethra terminates at the anterior part of the scrotum. There is a depression, but no canal, in the glans penis at the seat of the meatus. Between the glans and the point at which the urethra terminates, and whence the urine issues, the corpus spongiosum is deficient, and is replaced by a dense band of fibroid tissue somewhat resembling in hardness and tension the cicatrix of a burn. Hence there is not only absence of the penile portion of the urethra, but an absolute want of development of that part of the corpus spongiosum that lies between the glans and scrotum. When erection takes place, the organ assumes a crescentic shape, with the convexity upwards, the tense and hard cord that has just been mentioned stretching across its arc like the string of a bow, thus rendering connection impossible, and the sufferer practically impotent.

In such cases as these the organ may be greatly improved by dissecting through the cord in front of the urethral orifice, and behind the glans, separating the skin freely on each side, and then bringing it together in the mesial line. But the urethra cannot be lengthened, and hence both micturition and emission take place immediately in front of the scrotum.

**Epispadias.**—The upper surface of the penis is less frequently fissured; only, I believe, in cases of extroversion of the bladder. This condition, termed *epispadias*, may be remedied to some extent by Wood's operation, described at p. 840.

PHIMOSIS.—The prepuce is not unfrequently the seat of malformation or disease. The condition of it in which it is so much elongated that it extends beyond the glans, and at the same time is so much contracted that it prevents the proper exposure of this portion of the organ, is termed *phimosis*. This may be either congenital, or acquired as the result of inflammation or disease.

In **Congenital Phimosis**, the penis is usually somewhat atrophied, and the development of the glans is prevented by the pressure of the narrow prepuce. In congenital phimosis the skin is abundant and lax; but the mucous lining of the prepuce is short, contracted, and undeveloped. It is in this situation, and not in the skin, that the congenital defect is situated. In the majority of cases this condition is simply a source of local inconvenience; but it may become a cause of disease from a variety of causes. Thus in children the retention of the sebaceous secretion—the "smegma preputii"—under an elongated and tight foreskin, becomes a source of local irritation and inflammation from uncleanliness. The irritation thus kept up leads to local excitement, and favours the development of the habit of early masturbation (Fig. 826). In some cases the preputial orifice is so tight as to interfere materially with the discharge of the urine, which passes from the urethra into a kind of pouch between the glans and prepuce, distends this structure, and is then squeezed in a fine jet or in a scattered sprinkling stream through the narrowed preputial orifice, as a consequence of this impediment; and irritability of the bladder, often presenting symptoms simulating calculus, may thus be set up. Calculous concretions may form between the glans and the prepuce in such cases as these, and have been known to do so in enormous quantities. Whishaw, of Fyzabad, removed no fewer than 426 calculi, varying in size from a pin's head to a small bean, from this situation in the person of a native of India, 60 years of age, who came under treatment for what appeared to be a large tumour of the end of the penis, the true nature of which was not detected until in removing it the knife grated against the contained calculi. Various affections of the genito-urinary organs in children, such as incontinence, intermittent flow of urine, hæmaturia, priapism, &c., have been shown by Bryant to be owing to congenital phimosis. Sayre has pointed out the important fact that reflex paralysis and various forms of spastic contractions chiefly of the lower limbs are due to the same cause, being readily curable by circumcision. In addition to these I have seen general spasmodic affections in children resembling chorea, resulting from congenital phimosis.

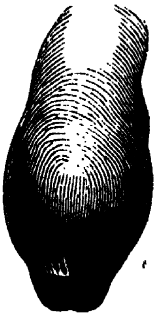


Fig. 826.—Irritated Congenital Phimosis.

At more advanced periods of life I have known it to be a cause of impotence, or rather as interfering with conception in the wife, by the semen after emission being retained under the tight and narrow prepuce until erection had completely subsided. Congenital phimosis especially becomes a source of inconvenience in after-life if any gonorrhœal or venereal disease be contracted, as it renders the exposure of the diseased part difficult or impossible, and interferes with the necessary treatment. In the opinion of some Surgeons, cancer of the penis, if not directly occasioned, is at all events predisposed to, by congenital phimosis.

**Acquired Phimosis** usually results from repeated attacks of inflammation, or of specific disease in the part, giving rise to solid œdema, or to false hypertrophy of the prepuce.

In elderly men, phimosis will sometimes slowly come on as a consequence of the irritation set up by cracks, fissures, or superficial ulcerations forming round the preputial orifice, which becomes narrowed, so as to prevent the glans from being uncovered. The preputial mucous membrane becomes thickened, and can be felt like a broad band under the loose and possibly slightly œdematous integument of the prepuce. This condition is a source of much irritation and annoyance, and requires relief by dilatation or removal by circumcision.

*Treatment.*—Every child who has a congenital phimosis ought to be circumcised ; and even those who, without having phimosis, have an abnormally long and lax prepuce, would be improved greatly in cleanliness, health, and morals by being subjected to the same operation ; and it would be well if the custom of Eastern nations, whether it be regarded as a religious rite or only a time-honoured observance, were introduced amongst us. Phimosis, when not congenital, must be treated in accordance with its cause ; thus, if it have resulted from inflammation, that must be subdued ; if from venereal disease, that must be remedied, when perhaps the contraction and elongation will gradually subside. If, however, the phimosis, though acquired, be permanent, it should be subjected to operation.

**Operations for Phimosis** may be conducted on three plans ; the elongated and contracted prepuce may be dilated or slit up, or circumcision may be performed.

1. *Dilatation of the Phimosis* may be done by putting the patient under chloroform, introducing a pair of forceps, and opening them widely, tearing through the narrow preputial orifice and tight funnel-shaped mucous membrane ; or this may be slit up with a narrow tenotome on each side, and then dilatation practised. This procedure may be usefully adopted if the prepuce be not very long and tight, or if any objection exist to circumcision as too severe an operation.

In the acquired phimosis of old men, consequent upon contraction following cracks of the preputial margin, I have found that dilatation may safely and speedily be effected by the introduction of a two-bladed dilator, such as is used for the female urethra, which, being gradually screwed open, causes the indurated circle to yield.

2. *Slitting up of the Prepuce,* whether upon its upper or under surface, is, I think, an objectionable procedure, leaving the prepuce of its abnormal length, and more or less fissured and knobbed. In all cases I prefer circum-

cision as the simplest and speediest operation, and as leaving the most satisfactory result.

3. **Circumcision for Congenital Phimosis in Boys.**—It may be gathered from what has already been stated with respect to the evil effects resulting from congenital phimosis, that circumcision in this condition may be required to remove an elongated and possibly adherent prepuce, which occasions much local irritation, or which is the exciting causes of reflex and distant nervous disturbance of a paralytic or spastic character. So great are the evils resulting not only from congenital phimosis, but from an abnormally long, though not phimotic prepuce, that it is only humane and right from a moral point of view, to practise early circumcision in all such cases. This operation is easily and safely performed according to the Hebrew rite, which I have several times had an opportunity of witnessing, and which is done as follows. The child being held on the lap of an assistant, the operator draws the foreskin slightly forwards, and then grasps it just in front of the glans by drawing it through a slit in a silver guard. This is not held perpendicularly downwards, but is inclined from above slightly forwards and downwards, so as to avoid cutting the frænum as much as possible, and to slice off the prepuce in an oblique or quilled manner. This is done by one stroke of a broad round-ended knife. The mucous membrane is then torn open between the finger and thumb along the dorsum of the penis, and is turned back so as to be brought into contact with the cut edge of the skin. A strip of dry lint is then twisted round the organ in the sulcus behind the glans, so as to keep back the mucous membrane, and also to restrain hæmorrhage by its pressure. Union is perfect in a few days. This operation, which is practised on the eighth day after birth, is very rarely attended by any ill consequences. I have, however, seen it in one case followed by fatal erysipelas, and have heard of another instance in which death occurred from hæmorrhage.

**Circumcision in the Adult for Disease of the Prepuce** may most conveniently be performed in the following way. The Surgeon restrains hæmorrhage during the operation, by tying a tape tightly round the root of the penis, or by compressing the organ in Clover's circumcision-tourniquet

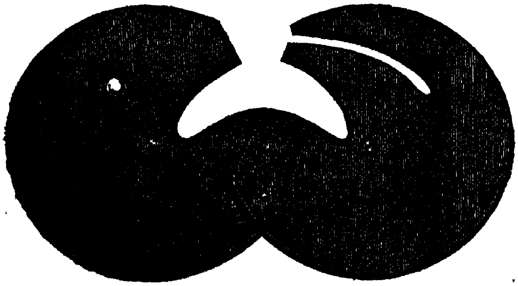


Fig. 827.—Clover's Circumcision Tourniquet (open).

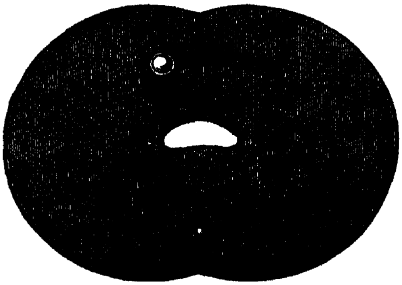


Fig. 828.—Clover's Circumcision Tourniquet (shut).

(Figs. 827, 828), a most useful instrument, which can be slackened or tightened at any time. He next draws the elongated prepuce slightly forwards, until that portion of it which corresponds to the back of the glans is brought just in front of that structure. He then seizes the projecting prepuce immediately in front of the glans with a pair of narrow-bladed polypus forceps, which he gives to an assistant, who must hold them tightly; or he grasps it and protects the glans by means of a plate (Fig. 829), which I have had constructed for this purpose. With one sweep of the bistoury he cuts off all that portion of the integument which projects beyond the forceps, which are then taken away (Fig. 830). It will now be found that he has only removed a circle of skin, but that the mucous membrane lining it still tightly embraces the glans; this he slits up, by introducing the point of a pair of scissors at the preputial orifice; and then, trimming off the angles of the flaps of mucous membrane, and if necessary snipping across the frænum, he turns back the mucous membrane, and attaches it to the edge of the cutaneous incision by five points of metallic suture, two on each side and one at the frænum. Before introducing these, he will generally find it necessary to ligature a small artery on each side of the penis, and one or two in the frænum. Union readily takes place by simple dressing; and a very narrow line of cicatrix is left, by which the patient is by no means inconvenienced. In some cases I have found adhesions between the prepuce and the glans; these require to be torn or dissected through, but no inconvenience results from this slight addition to the operation.

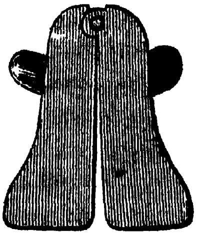


Fig. 829.—Instrument for holding the Prepuce in Circumcision.

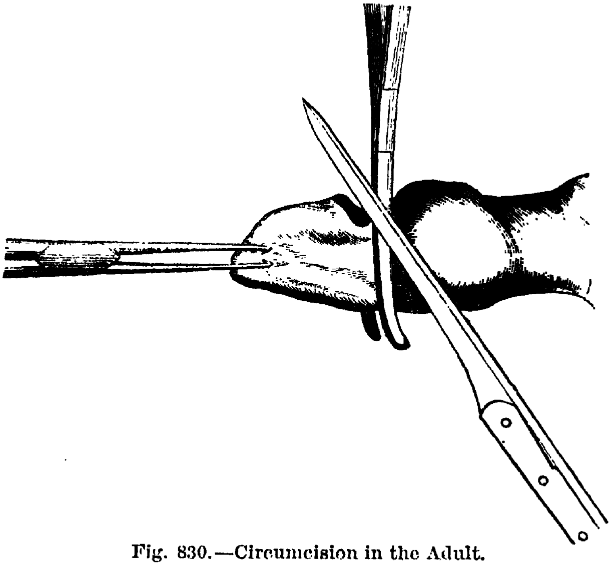


Fig. 830.—Circumcision in the Adult.

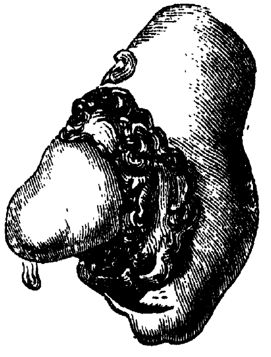


Fig. 831. — Sloughing of the Prepuce, and Protrusion of the Glans.

If sloughing of the prepuce have occurred, allowing the glans to protrude, as in Fig. 831, circumcision must be practised.

The chief points to be attended to in the performance of this operation, and on which its after success is most dependent, are—1, That too much skin be not removed; 2, That the mucous membrane be slit up to the base of the glans; 3, That as little as possible of it be removed; 4, That all bleeding vessels be tied; 5, That the mucous membrane be well turned back, so as to cover in the gap left by the retracted skin; 6, That the ligatures be left long; 7, That as few sutures as possible be used.

**Paraphimosis.**—In *paraphimosis* the prepuce has been forcibly drawn back behind the glans, which becomes strangled by the pressure exercised by the preputial orifice, so that the parts cannot be replaced in proper relation to one another. This accident principally occurs in boys, or in individuals who have naturally a tight prepuce, and who, on uncovering the glans, find it difficult to get this part of the organ back. This difficulty is speedily and greatly increased by the swelling from congestion that is set up in the constricted glans.

*Treatment.*—This is sufficiently simple. The Surgeon should first try to reduce the swollen organ. He may often succeed in doing this by seizing the body of the penis between the index and middle fingers of each hand, and then endeavouring to draw the prepuce forwards, at the same time that he compresses the glans between the two thumbs and pushes it back (Fig. 832). Should reduction not be effected in this way, the constricted and strangulating preputial orifice must be divided. In doing this, the Surgeon will observe that the glans is separated from the body of the penis by a deep and narrow sulcus, which is especially evident on the upper part of the organ. This sulcus, which is overlapped on one side by the glans and on the other by a fold of integument, corresponds to the inner margin of the preputial orifice; and it is by the division of this, in which the stricture is situated, that immediate relief will be given. This operation may readily be done by drawing the glans forwards, then passing the point of a narrow-bladed scalpel into the sulcus on the dorsum of the penis, and making a perpendicular incision about one-third of an inch in length through the integuments at the bottom of the groove directly across it (Fig. 833). In consequence of the great stretching of the parts, the incision will immediately gape widely; so that, instead of being longitudinal, it will appear to be transverse; and then reduction of the glans may readily be effected.

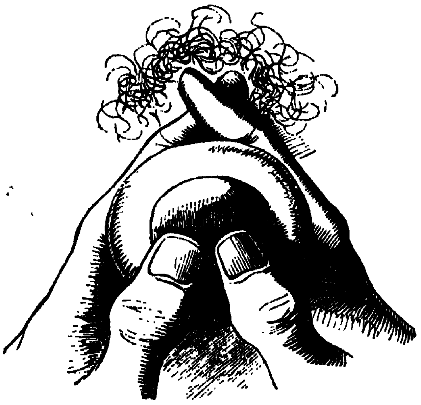


Fig. 832.—Reduction of Paraphimosis.

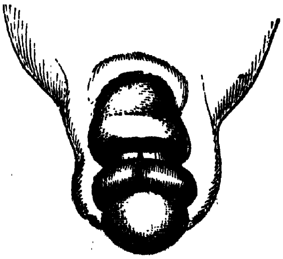


Fig. 833.—Incision in Operation for Paraphimosis.

**Balanitis.**—Inflammation of the prepuce commonly occurs as the result of local irritation from want of cleanliness, not unfrequently set up by a gonorrhœa. When confined to the prepuce, and constituting *balanitis*, that structure is much swollen, infiltrated, and reddened, and, while the inflammation lasts, continues in a state of phimosis. When the mucous membrane of the glans is affected as well, constituting *Posthitis*, there is a good deal of irritation and smarting, together with muco-purulent discharge.

*Treatment.*—The disease requires to be treated on ordinary antiphlogistic principles. The continued application of lead lotion, with the internal administration of salines, will generally remove it; but in many instances the most effectual plan will be found to consist in rapidly sweeping the inflamed surfaces with a stick of nitrate of silver passed down between them on one side of the fræenum, and carried round to the opposite side.

**Herpes of the Glans and Prepuce** is characterised by the formation of small vesicles or excoriated points upon the mucous membrane of this region, attended by much smarting and itching, and chiefly occurring in persons of a gouty habit of body, with an irritable mucous membrane.

*Treatment.*—This slight affection is often very rebellious to treatment. In many instances, local means alone will not suffice; for, though relief may be obtained by powdering the part with the oxide of zinc, or by using slightly astringent and cooling lotions, yet no permanent benefit will be derived unless constitutional irritation be removed by treatment of a cooling or alterative character, modified according to the circumstances of the case.

**Hypertrophy of the Prepuce** not unfrequently occurs as the result of chronic irritation or disease; it is usually of limited extent, and requires no special interference on the part of the Surgeon; but in some instances it may become so extensive as to require operative interference. The disease then usually consists of a solid œdema of the areolar tissue of the prepuce and of the subintegumental structures of the body of the penis, the organ being very greatly enlarged and becoming club-shaped. In these cases circumcision of the hypertrophied prepuce, with the excision of a V-shaped piece from the dorsum of the penis, will usually be found to leave a good and satisfactory result. But a greater magnitude than this may be attained. Thus Vidal has related and figured a case that had attained such an enormous size, that the organ reached to below the knees, and was as large as a thigh. This monstrous growth was successfully excised.

**Warts** on the penis have already been described. They may attain a very large size, as in Fig. 834, and are best treated by being snipped off with curved scissors.

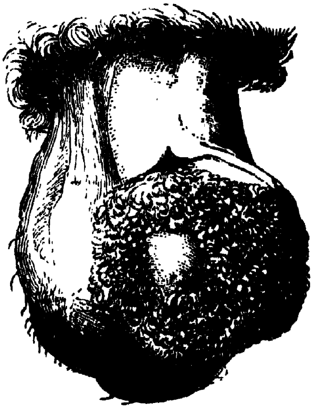


Fig. 834.—Warts on the Glans and inner side of Prepuce, which is slit up.

**Horny Excrescences** have been observed to spring from the glans penis. The most remarkable case of this kind in record is one by Jewett of Connecticut. It was that of a young man, in whom, after operation for congenital phimosis and the removal of warts, a horn grew from the left side of the glans penis, and attained a size of three and a half inches in length by three-fourths of an inch in diameter at the base. It could be handled and cut without pain, and the patient "was accustomed to amuse the inmates of the ward by lighting the end of the horn and allowing it to burn." It was excised, and did not return.

**Persistent Priapism,** lasting for many days, is occasionally met with, as the result in most cases of excessive venery. The erection of the penis is not accompanied by any sexual desire, but is attended with great pain, a sense of weight about the perinæum, much anxiety, and constitutional disturbance. The organ is singularly hard and unyielding. The pathology of this condition is obscure. By some it has been considered as the result of extravasation of blood into the corpora cavernosa; by others, as dependent on sympathetic or reflex nervous irritation. The effect of treatment would lead to the inference that the latter view was correct. The incisions into the corpora cavernosa to let out the blood supposed to be extravasated have been productive of no great result, whilst the erection has rapidly subsided under full doses of the bromide of potassium.

**Gangrene of the Penis.**—Sloughing of the integuments of the penis, to a greater or less extent, not unfrequently occurs in persons of broken constitution as the result of inflammatory phimosis, simple or gonorrheal (Fig. 831); or in consequence of the invasion of syphilitic phagedæna, and indeed the glans and body of the organ may often be extensively destroyed by the latter cause. These various forms of the disease have been described in different parts of this work.

The true *idiopathic gangrene* of the penis is, however, a very rare disease; and Demarquay, who has specially directed attention to it, finds but few instances of it in the records of surgery. It has chiefly been met with in people of advanced age or of broken constitution, who, whilst suffering from some local disease of the organ, have been affected by acute febrile disease, such as typhoid or small-pox, or have become the subjects of pyæmia. In some cases it is probably embolic. The disease, when affecting the body of the penis, is often fatal—possibly by hæmorrhage on the separation of the slough. When the glans only is attacked, the prospect is better. But in either case—especially in the former—mutilation of the organ to a serious extent will result.

The *Treatment* of gangrene of the penis presents nothing special, with the exception of restraining hæmorrhage by means of the actual cautery, and preventing or repairing loss of substance in the urethral wall, if it have been invaded by the disease and involved in the destruction resulting.

**Fibroid Tumour of the Penis.**—The penis may be the seat of fibroid and other tumours. The accompanying drawing (Fig. 835) is an illustration of one which I removed some years ago from the under surface of the organ.

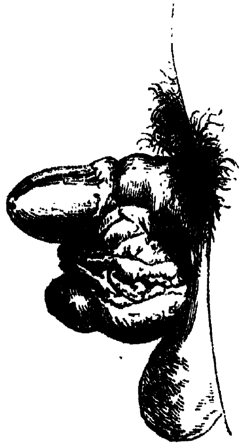


Fig. 835.—Fibroid Tumour of the Penis, successfully removed.

**Cancer of the Penis** is of two distinct kinds, occurring as Scirrhus or as Epithelioma. When cancer assumes the *Scirrhous* form, it usually springs from the sulcus behind the glans, and may thence invade the neighbouring portion of the organ. It may assume the primary form either of a tubercle or of infiltrated cancer of the glans. It has been supposed, and with some show of reason, that congenital phimosis predisposes to the affection; probably by confining the secretions, and thus keeping up irritation of the part. Hey found that, of 12 patients with this disease who came under his observation, 9 had congenital phimosis; and Travers states that Jews, who are circumcised, are seldom subject to this affection. But as they are a limited community in this country, and as the disease is rare, we cannot draw any conclusive inference from this observation. It is, however, very probable that the epithelial form of the disease may arise from the local irritation resulting from congenital phimosis. The scirrhous form of the affection, however, can occur in individuals who have not suffered from phimosis; of this I have seen several instances at the University College Hospital.

**Epithelioma,** commencing as a tubercle in the prepuce, may, after a time, give rise to a large irregular and sprouting mass, having a granular fungous appearance, bleeding with much fetid discharge, growing rapidly, enveloping and at last implicating the glans (Fig. 836). In other cases it commences as a hard scirrhous mass of a pale reddish-white colour, situated on the glans, or between the prepuce and the glans. This increases in size, at last cracks, and allows a serous fetid discharge to exude. Ulceration then rapidly takes place. Sometimes the disease appears to be very distinctly localised; but after its removal it will always present the character of infiltrated cancer. It is, I believe, always primarily situated at the anterior extremity of the penis, not occurring in the body of the organ except as a secondary deposit.

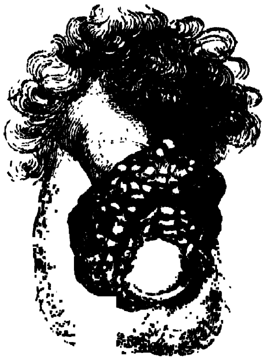


Fig. 836.—Epithelioma of the Penis.

*Diagnosis.*—Epithelioma of the penis requires to be diagnosed from *fungoid warts.* This may usually be done readily enough, by comparing the indurated state of the malignant with the soft and lax condition of the non-malignant affection. From *chancrous induration* of the glans, the history of the case and the way in which it is influenced by treatment will enable the Surgeon to effect the diagnosis of scirrhus. In *indurated plastic effusions* into the corpus spongiosum, no pain is experienced, and the disease remains in a stationary condition.

*Treatment.*—The treatment of cancer of the penis will vary according to the nature and extent of the malignant affection.

In the **Epithelial** form of the disease the Surgeon may, if he see the case early, whilst the morbid growth is small and limited to the prepuce, content himself with dissecting off the affected patch. Should the epithelioma, however, have attained a large size (Fig. 836), and more particularly if it have implicated the glans, then amputation of the organ is indicated.

The treatment of **Cancer** of the penis must be conducted on the principles that guide us in the management of malignant affections wherever situated; viz., to remove the diseased organ at as early a stage as possible, whilst the affection is localised, before the glands are implicated and the constitution poisoned. In the penis, this may readily be done by an operation that is simple in its execution and nearly devoid of danger. In many cases a return may take place, and that speedily, either in the part itself or in the neighbouring lymphatic glands; yet, even if this occur, it is clearly the duty of the Surgeon to rid the patient of a loathsome disease, and to put him in a state of comparative comfort for some time; the more so, as there is reason to believe that, in some instances, the disease may be entirely extirpated from the system, evincing no tendency to return. Indeed, I believe that amputation of the penis for cancer is more successful in its results than is the extirpation of malignant growths from most other situations. In the epithelial form of the disease it is especially a useful operation. In some of Hey's cases, which continued under his observation, there was no recurrence of the disease for several years. I have seen several patients who, after a lapse of six or eight years, have continued free from a recurrence of the disease; and I have also seen a gentleman who had his penis amputated for cancer more than twenty-five years ago, and in whom no return has taken place. The fact is, that we see and hear of those cases in which a recurrence takes place; but those patients who remain free from a return of the affection do not divulge their infirmity; and it is exceedingly rare in hospital practice to find a patient come back with recurrent cancer in the stump of the penis, which he would certainly do if relapse took place. In those cases in which the operation is not successful, it has usually been delayed too long, the disease having already implicated the lymphatic glands in the groin, and thus contaminated the patient's constitution.

**Amputation of the Penis** may be practised either with the knife or with the écraseur. Whichever instrument is used, the operation should always be performed towards the root of the organ, so as to be well clear of the disease; at the same time, care must be taken not to remove the organ too near the pubes, lest the stump retract under that bone. Before proceeding to operate, means must be taken to restrain undue hæmorrhage. This is best done by tying a narrow tape tightly round the root of the penis, or by encircling this part by Clover's tourniquet (Figs. 827, 828), applied as in circumcision, only nearer to the pubes and more tightly. The operation with the knife may readily be done by the Surgeon putting the penis upon the stretch, drawing the integument well *forward*, and then severing the organ at one stroke of the bistoury. As the corpora cavernosa retract more than the integument, it is well not to leave too much skin; lest the flap, falling over the face of the stump, make the search for any bleeding vessels somewhat difficult, and afterwards pucker inconveniently. There are usually five arteries requiring ligature: the dorsales penis, one in each corpus cavernosum, and one in the septum. In securing these, trouble is not unfrequently experienced in consequence of the retraction of the stump that is left. The danger of hæmorrhage scarcely exists if the tape or the tourniquet have been properly applied before the operation, as every artery should be secured before the compression is taken off. By these means we may prevent the retraction of the stump, which may otherwise cause it to be buried under the pubic arch, almost in the perinæum. Should it do so, and oozing continue, a female catheter must be passed into the urethra, and a firm compress applied with a T-bandage. During and after cicatrisation, the urethral orifice has a tendency to contract. The liability to this may, however, be lessened by slitting up the lower wall of the urethra with sharp-pointed scissors for about a quarter of an inch, drawing forward the mucous membrane, and then stitching it to the edge of the cut skin. If the amputation be performed high up, this may be somewhat difficult; and then it may be safer to introduce an elastic catheter before the operation, to perform the amputation upon and through this, and to leave it in during cicatrisation. When the écraseur is used, the skin should similarly be drawn forwards, and the instrument worked slowly, so as to divide the organ, if possible, without inducing hæmorrhage. During the healing, the cut surfaces should be kept scrupulously clean with antiseptics, lest septic poisoning takes place, which may readily occur in so spongy and vascular an organ.

I have employed the galvanic écraseur with great success in removal of the penis. The operation thus performed is bloodless. The plan that I adopt is as follows. A full-sized silver catheter having no rings is first passed into the bladder, and is retained there during and after the operation. A narrow tape is then tied round the root of the penis to compress the vessels. The wire of the écraseur is next slipped over the fore part of the organ, and is worked until the tissues are divided through to the catheter. The separated portion of the penis is then slipped off over the catheter, which is tied in. The object of passing the catheter before dividing the organ is to avoid the difficulty that often occurs in finding the urethral aperture in the stump when compressed and seared by the wire, and the object of retaining it is to prevent contraction of that orifice during cicatrisation.

After amputation of the penis, the urine will not be projected forwards, but always passes directly downwards between the legs. Any inconvenience in this respect may best be avoided by following Ambrose Paré's advice of adapting a funnel, which may be made of metal or ivory, to the pubes over the stump, and thus carrying the urine clear of the person.

Other tumours besides cancer are occasionally met with in the penis. I have seen *Encysted Tumours* and *Nævus* situated under the prepuce (p. 942, Vol. I.); and *Fibrous or Fibro-Plastic Tumour* may occur in the corpora cavernosa. Such morbid growths if small can readily be removed without injury to the rest of the organ; if large, they may require its amputation.

## DISEASES OF THE SCROTUM.

**Inflammatory Œdema** of the scrotum is an erysipelatous inflammation of this region, and derives its chief peculiarity from the circumstance of its giving rise to great effusion into and swelling of the areolar tissue of this part and of the penis, with a tendency to the rapid formation of slough in it, by which the integument may likewise become affected to such an extent that the testes and cords speedily become denuded. This disease usually originates from some local source of irritation, as fissures, cracks, or urinary extravasation (p. 702, Vol. I.). There is a peculiar and specific form of "inflammatory œdema" of the scrotum and penis, which is apt to occur as a sequence of small pox and scarlet fever. In this form of the disease rapid and extensive infiltration of the parts occurs, with a tendency to speedy gangrenous disorganisation of the areolar tissue and skin covering the organs of generation.

*Treatment.*—This consists in elevating the scrotum, fomenting it well, and making early and free incisions into it, particularly at the posterior and dependent parts of the scrotum and penis, with the review of relieving the tension to which the tissue is subjected by the effusion into its cells, and thus preventing the liability to slough. Should this occur, the case must be treated on ordinary principles, when cicatrisation will speedily ensue, however extensive the denudation of parts may be. The constitutional management must always be conducted in accordance with those principles laid down in the first division of this work, and with special attention to the maintenance of the patient's strength.

**Hypertrophy** of the scrotum seldom occurs in this country, though Liston once had occasion to remove such a mass, weighing 44 lbs.; but in some tropical regions, particularly India and China, it is of frequent occurrence, and may go on until it attain an enormous bulk, forming a tumour nearly as large as the trunk, and perhaps weighing 60 or 70 lbs. These enormous growths are of simple character, and constitute the disease termed *Elephantiasis of the scrotum.* Fig. 837 represents a tumour of this kind, weighing 40 lbs., which was successfully removed by Rogers of the Mauritius. It is taken from a photograph of the case, kindly sent to me by that gentleman.

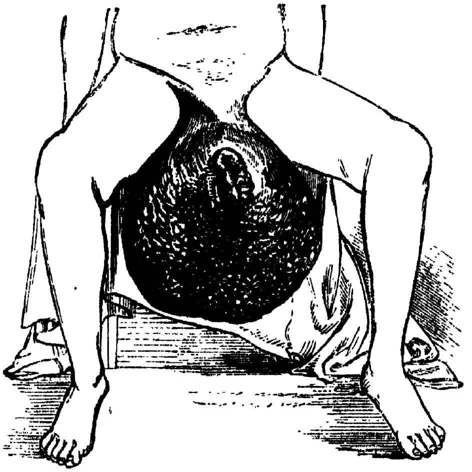


Fig. 837.—Elephantiasis of the Scrotum.

*Treatment.*—Tumours of this kind necessarily require extirpation. In performing such operations, there are two points that demand special attention; the first is to preserve the penis and testes if possible, which will usually be found buried towards the upper part of the mass, and may be saved if the tumour be of small size; and the second is, to endeavour to prevent the hæmorrhage from being too profuse. With this view, the operation ought not only to be performed as rapidly as possible, but the advice given by O'Ferrall of elevating the tumour above the level of the body, for some time before its removal, so as to empty it of its blood, may be advantageously adopted. In addition to this, Esmarch's tourniquet should be applied round the neck of the tumour and the pelvis. If the growth be very large, it will be better not to make any attempt at saving the testes or penis, which could only be dissected out by a long and tedious operation, in the course of which there would be danger of the patient dying of hæmorrhage.

**Epithelioma** occasionally affects the scrotum; and, as it principally occurs in chimney-sweepers, it has been appropriately enough termed *Chimney-sweeper's Cancer.* This affection appears to arise from the irritation of the soot lodging in the folds of the scrotum. It commonly commences as a tubercle or wart, which after a time cracks or ulcerates, presenting the ordinary characters of a cancerous ulceration. It rapidly spreads, involving at last the greater part of the scrotum, and perhaps invading the testis. After a time, the inguinal and pelvic glands will be affected; and the patient, if deprived of his covering of soot, will be found to be cachectic-looking.

The *Treatment* consists in excising widely the diseased portion of the scrotum, provided the inguinal glands be not involved, or the patient's constitution poisoned. The disease has a great tendency to return, and it is seldom that the patient long escapes with life when once he has been affected by it.

# CHAPTER LXXIV.

## DISEASES OF THE TESTIS AND CORD.

### MALPOSITION OF THE TESTIS.

The testes are, in the fœtus, lumbar organs lying below the kidneys, and in the normal condition descend into the scrotum a short time before birth. From some arrest of development, this descent may be retarded on one or both sides; and in other instances it is never completed. An undescended testis may continue to lie within the cavity of the abdomen; or it may find its way into the internal ring; or may become engaged in the inguinal canal, lying above the external abdominal ring, or it may project just beyond this, not passing into the scrotum. In these several situations it may remain quiescent; but it may become the seat of inflammation or of structural degeneration, simple or malignant. It may also, when undescended, as has been stated at p. 659, Vol. II., become complicated with or mistaken for a hernia, and may present many diagnostic difficulties. Inflammation of the testis retained in the canal will be considered at p. 945. When an undescended testis becomes the seat of structural disease, it may require removal from the canal. The testis may be met with in other abnormal situations; thus some time ago I saw a case in which one of these organs was situated in the perinæum, close by the anus, having apparently missed the scrotum; and cases have occurred in which they have been met with in the interior of the pelvis. The organ may sometimes be turned hindside forwards, being retroverted, so that the epididymis is placed in front. In a case of this kind which I had an opportunity of examining after death a few years ago, the epipidymis and vas deferens were considerably larger than natural. If a hydrocele form in such a case, it will be seated behind the testis.

There is a very important question connected with malposition of the testis, viz. Is the organ when undescended prolific? There is reason to believe that it is not. Such testes are small, hard, and granular in structure; and, when they are examined under the microscope, spermatozoa are not found in them. When only one testis is undescended, the other one, being in its proper position, carries on the functions of the two organs; but when both testes are retained in the canal or in the abdomen, being undescended, the individual who is the subject of such malposition will most probably be sterile. He may have the usual erotic feelings, full power of erection, and of emission of a spermatic fluid; but the secretion will probably have no fecundating power.

## NEURALGIA OF THE TESTIS.

A painful or irritable condition of the testicle may occur without any actual disease of the organ; the pain being either seated in the epididymis, which is the part naturally the most tender, in the body of the testis, or stretching along the cord to the loins and groins. It is usually paroxysmal, and is accompanied by great tenderness, and commonly by some fulness of the organ, which feels soft and flaccid; but it is difficult to make a proper examination, on account of the agony that is induced by touching the part. This disease chiefly occurs in young men of a nervous and excitable temperament, and is frequently associated with great mental disquietude and despondency, often amounting to a suicidal tendency.

The *Causes* are obscure; in many cases the disease appears to be connected with a neuralgic temperament, but in others it is associated with some dyspeptic disorder, or may be dependent upon local irritation; thus external piles, or the pressure of a varicocele, will often give rise to it.

The disease is usually of a very chronic character. In some instances, however, it ceases spontaneously, after having lasted for weeks or months.

*Treatment.*—When the neuralgia is dependent upon constitutional causes, the treatment is extremely unsatisfactory. The administration of tonics, such as iron, zinc, or quinine, the local application of sedatives, as of atropine ointment or the tincture of aconite, may be of service. In other cases, cold bathing or douching will be beneficial; and, in all, keeping the part supported with a suspensory bandage will be advantageous. In the event of there being any local irritation, that should be removed; thus I have known the disease to cease after the excision of external piles; and when it is connected with varicocele, proper measures must be adopted for the relief of that affection.

In extreme cases, Sir A. Cooper recommends castration; but such a proceeding is altogether unjustifiable in a disease that is either constitutional, or dependent on local causes which are readily removable.

## INFLAMMATION OF THE TESTIS.

**Inflammation of the Testicle,** considering the organ as a whole, may be of two distinct kinds, varying as to seat and as to cause. Thus it may be seated in the body of the organ, constituting *Orchitis;* or the epididymis may alone be affected, constituting *Epididymitis.* As to cause, it may be rheumatic, traumatic, or gonorrhœal.

**Acute Inflammation.**—The *Seat* of the inflammation, at the commencement of the disease, depends greatly upon the cause, which may be in the urinary passages or elsewhere. Irritation in any part of the urethra, occasioned by the passage of instruments, by the lodgment of calculi, or by gonorrhœal inflammation, usually causes the epididymis to be primarily affected, and the body of the organ to be inflamed in a secondary manner. When, on the other hand, the inflammation comes on from injuries, blows, strains, or other causes acting generally, the body of the testis is usually first affected. To all this, however, exceptions will often occur; and orchitis may supervene as the result of gonorrhœa, or epididymitis from a blow. The orchitis in such cases is in all probability a kind of constitutional affection, intimately associated with inflammation of other fibrous tissues, especially with gonorrhœal rheumatism ; the inflammation of the epididymis, arising from gonorrhœa or other irritation of the urinary passage, appearing to result from direct extension of morbid action along the vas deferens.

*Symptoms.*—These necessarily vary to a certain extent, not only according as the disease is of an acute or of a chronic character, but as it primarily affects the body of the testis or the epididymis. When it commences in the latter structure, it is the inferior globus that is commonly first affected, which becomes swollen, hard, and tender. The disease may be confined throughout to this part ; but most frequently it invades the whole of the organ, which becomes uniformly enlarged and somewhat ovoid ; it is frequently accompanied by a good deal of effusion into the tunica vaginalis, then constituting the *Acute Hydrocele* of Velpeau. As the inflammation subsides, the different characters presented by the enlargement of the two constituents of the organ again become apparent. The swelling is therefore due partly to general enlargement of the organ, but in some cases to inflammatory effusion into the tunica vaginalis ; and this effusion may either be purely serous, or partly plastic.

The pain is always very severe, with much tenderness and a sensation of weight, and commonly extends up the cord into the groin and loin. It is generally greatest when the body of the testis is affected, owing probably to the enveloping fibrous tunic preventing the expansion of the organ. Hence it is often spasmodic and paroxysmal, extending up the course of the cord. There are usually considerable swelling and redness of the scrotum, with turgescence of the scrotal veins, and a congested state of the cord, with sharp pyrexia, nausea, and perhaps occasional vomiting.

As the disease subsides, the body of the testis first resumes its normal character and shape, the epididymis often continuing hardened and enlarged for a considerable period. In fact, the induration that forms in the epididymis may become somewhat permanent, owing to the effusion of plastic matter into it, leaving a hardened mass, and implicating the whole or a portion of its convolutions.

**Atrophy of the Testis** is more liable to follow the metastatic orchitis of mumps in young men above the age of puberty than any other form of inflammation of the organ. It is remarkable how rapid and how complete the wasting of the testis will be in these cases. A few weeks after the subsidence of the inflammation the testis will be found to be shrunk away, so as to form a small soft mass not larger than a filbert.

Atrophy of the testis may also sometimes gradually ensue as a result of chronic epididymitis, and the consequent induration of this structure. Strangulation of the vascular supply to the testis occurs, and the whole organ at last wastes so as to leave nothing but a small hardened mass in the scrotum. Gosselin has shown that this induration of the epididymis following inflammation frequently causes complete obstruction of the canal, and if occurring on both sides produces sterility. In 19 such cases he found spermatozoa absent from the semen, and the patients consequently incapable of procreation, although the appearance of the testes and of their secretion was scarcely altered, and the virile powers of the patients remained unimpaired. Curling also mentions several such cases, and points out the necessity of continuing the treatment of epididymitis until the last trace of induration has disappeared. At a later period, treatment is almost useless.

**Subacute Orchitis** usually comes on with the same symptoms, though in a less marked form than in the acute variety. This swelling, however, is considerable, though of a softer kind. When the disease is chronic, the testis often becomes permanently enlarged and hardened, assuming an oval shape, being smooth, heavy, and uniformly expanded, with a sensation of weight, dragging, and severe pain, and a good deal of tenderness on pressure. This form of orchitis occasionally occurs in old people.

Orchitis may occur idiopathically, without any assignable cause in the way of external injury or local irritation in the urethra or prostate. This form of the disease is most common in middle-aged men, and more especially in those who are gouty. In fact the disease is in all probability one of the many local forms of gouty inflammation. It is not very acute but lingering, liable to recurrence, and to be followed either by hydrocele or chronic indurations of the epididymis.

*Treatment.*—The treatment of **Acutely Inflamed Testicle**, whether local or constitutional, is essentially antiphlogistic. Blood should be abstracted from the part by puncturing the veins of the scrotum—a far better method than applying leeches, the bites of which are apt to become irritated. This little operation may be very effectually done by directing the patient to stand up, and to foment the scrotum for a few minutes with a hot sponge, so as to distend the veins ; these may then be punctured at various points with a fine lancet, and the parts well fomented afterwards, so as to encourage the flow of blood. In this way six or eight ounces may be taken in the course of a few minutes ; when enough has escaped, the further flow may be arrested by laying the patient down and elevating the part.

The patient should be kept in bed with the testis raised on a small pillow between the thighs, poppy fomentations being diligently applied. If there be much effusion into the tunica vaginalis, constituting acute hydrocele, relief may be afforded by puncturing this sac with the point of the lancet.

The *Constitutional Treatment* during the acute stage consists in the administration of salines and antimony, with henbane in full doses, so as to give an aperient, a diaphoretic, and a sedative together ; when this begins to act, great relief is usually afforded.

As the inflammation subsides, the treatment must be changed. When there is merely swelling and hardness left, with but little pain or tenderness, the testis may advantageously be strapped with adhesive plaster, so as to give good support and to promote absorption of plastic matter. Fricke of Hamburg has strongly recommended strapping in the acute stage ; but I cannot say that I have ever seen any advantages derived from it at this period of the disease, though I have many times seen it tried ; it has usually appeared to me to increase, sometimes very considerably, the pain in the part, and the general uneasiness.

In **Subacute Orchitis** much benefit is usually derived from a short course of Dover's powder and calomel, with early strapping of the testis. When the organ has become enlarged and indurated, as the result of chronic inflammation, it may be advantageously strapped either with simple plaster, or with one composed of equal parts of the emplastrum ammoniaci cum hydrargyro and soap-plaster; mercury in small doses, more especially the bichloride, being continued for some length of time, until the plastic matter is absorbed and the hardness disappears.

In **Strapping a Testicle,** the scrotum should be shaved, and then drawn tightly upwards on the affected side. The Surgeon should next pass a long strip of plaster, above an inch broad, above the enlarged testicle and round the corresponding side of the scrotum, so as to isolate it, as it were. Another strip is now passed from behind, in a longitudinal direction, over the lower end of the testis, and upwards upon the anterior part of the scrotum: and thus, by a succession of horizontal and vertical strips, neatly overlapping and drawn tightly, the organ is completely enveloped and compressed. To be of any service, the strapping must be tightly and evenly applied; but at the same time care must be taken not to strangulate the scrotum by drawing down the upper strips of plaster too forcibly. In a case of "tuberculo-syphilitic" disease of the testis, in which I was obliged to have recourse to castration, the whole of the side of the scrotum had sloughed away, leaving the testis exposed and fungating, in consequence of the tight strapping which had been employed before the case came into my hands.

**Abscess,** as the result of inflammation of the testis, is of rare occurrence: sometimes, however, the scrotum inflames at one point, where fluctuation becomes apparent, with thinned skin and evident signs of suppuration; a puncture should here be made, and the pus let out as soon as formed. Sometimes abscess may occur in another way; inflammation is set up in the tunica albuginea, adhesion takes place between the testis and the scrotum, abscess forms under the fibrous coat, and, this giving way, the pus gets vent externally through the integuments. Into the aperture that necessarily results a portion of the secreting tissue of the gland sometimes projects, and, becoming inflamed, forms a red, granular, and fungous mass, protruding through and overlapping the edges of the aperture. The treatment of this condition will be considered when we come to speak of the scrofulous testicle.

**Inflammation of the Testis in the Inguinal Canal** may sometimes take place, even in adults, when the organ has not descended through the external ring; giving rise to a train of somewhat puzzling symptoms which closely resemble those of strangulated incomplete hernia; with which, however, it must be borne in mind that it may be associated (p. 659, vol. II). On examination, a large irregular tumour, in some parts hard, in others soft, very tender to the touch, and occasioning a sickening sensation when pressed, will be found in one of the groins, in the situation of the inguinal canal. There are usually a tendency to vomiting and some constipation, with colicky pains in the abdomen. These symptoms, however, are generally not very persistent, and the constipation readily yields to the administration of purgatives. On examining the scrotum, it will be found that the testis on the affected side is absent; and, on passing the finger into the external ring, the organ can be felt to be lodged in the canal. In consequence of the proximity of the peritoneum to the inflamed testis, this membrane occasionally becomes involved in the morbid action; and, as the result of the constriction of the tendinous and aponeurotic tissues in the situation, sloughing has occasionally occurred. Either of these conditions may lead to a fatal termination.

The *Treatment* should be actively antiphlogistic. Leeches must be freely applied over the part, and blood should be taken from the arm, if the patient be young and strong; salines with antimony being at the same time administered, and fomentations diligently persevered in.

**Inflammation and Abscess of the Cord.**—In some cases the inflammation of the testis may extend, or the disease may, from the first, be limited, to the areolar tissue of the cord, giving rise to tumefaction, with a good deal of pain and tenderness along it, and eventually abscess, accompanied by the usual signs of suppuration. The *Treatment* of such a case must be conducted on ordinary principles, early discharge for the pus being secured.

**Chronic Orchitis** of a persistent character constitutes a distinct disease of the testis, so closely allied to some forms of tumour of this organ in its character and pathology, that it will be more convenient to consider it with the *Sarcoceles* (p. 960).

### HYDROCELE AND HÆMATOCELE.

By **Hydrocele** is meant an accumulation of serous fluid, formed in connection with the testis or cord. Most frequently the fluid occupies the sac of the tunica vaginalis, constituting a true dropsy of it; in other instances, it appears to be formed in distinct cysts, situated either in connection with the testis, or upon the cord. Hence hydroceles are commonly divided into those that affect the *Tunica Vaginalis*, and the *Encysted* variety.

HYDROCELE OF THE TUNICA VAGINALIS may occur as the result of acute orchitis; the inflammation of the testis causing the effusion of a quantity of limpid fluid into its serous investment (p. 943). This, however, is not the kind of hydrocele that is commonly met with; the fluid so poured out as the result of active inflammation usually becoming absorbed as the parts recover their normal condition. The ordinary hydrocele occurs as a chronic disease, without any signs of inflammation of the testicle, or, at most, with but slight tenderness of that organ. It is most frequently met with in individuals about the middle period of life, commonly without any evident exciting cause, either constitutional or local. It is very common in men who have lived long in warm climates, and Fayrer considers it in some cases to have a malarial origin.

In young infants, hydrocele is not unfrequently seen, and in them it may affect two forms: either the ordinary one, similar to that which occurs in adults in whom the tunica vaginalis constitutes a closed sac filled with fluid; or a less common variety, in which the accumulation of fluid in the tunica vaginalis communicates, by the persistence of a canal in the funicular prolongation of the peritoneum investing the cord, with the general cavity of that membrane. This form of hydrocele is *Congenital;* and the fluid in it occupies the same position that intestine does in a congenital hernia. It may readily be recognised by the fluid being made to flow back into the general peritoneal cavity, on raising or squeezing the tumour. But, although this may be considered to be the true congenital form of hydrocele in infants, the other variety of the disease also occurs in them when but a few days old, and very possibly even at the time of birth.

*Symptoms.*—The symptoms of hydrocele are tolerably evident. The disease begins with a degree of swelling and weight about the testis: the swelling may at first be soft, but after a while becomes hard and tense; or it may be so from the commencement. Whatever its original condition, the tumour soon becomes oval or pyriform in shape, being narrowed above, rounded and broad below: it is smooth and uniformly tense and hard, often having a semi-elastic feel. It reaches upwards along the cord, towards the external abdominal ring, which, however, is rarely invaded by it, and the cord is usually distinctly to be felt above the upper margin of the tumour. Most commonly the size varies from that of a hen's egg to a small cocoa-nut; but sometimes it may attain a considerably greater magnitude than this, and will then cause much inconvenience, as it reaches up close to the external ring, and drags over the penis, causing that organ to be buried in it, so as to interfere with micturition. Gibbon the historian had an enormous hydrocele, which was tapped by Cline, who drew off six quarts of fluid.

The most characteristic sign of hydrocele is its translucency by transmitted light. This may always be detected by the Surgeon grasping the posterior part of the tumour with one hand, so as to put the integuments of the fore part on the stretch, then placing the edge of the other hand along the most prominent part of the swelling, and having a lighted candle held close behind. On making this examination, the tumour will appear translucent; if, however, the walls of the sac be thick, or the fluid dark, the transmission of light through it may not be perceived unless the examination be conducted in a darkened room. Another very simple and efficient method of determining the translucency is by putting the end of a stethoscope against the tumour, and looking down the tube against the light.

We have already seen that the ordinary hydrocele of the tunica vaginalis may vary as to size: it may also differ as to shape; in some cases being globular, in others constricted in the middle, or of an hour-glass shape.

The quantity of liquid varies considerably; there are usually from six to twelve or twenty ounces, but I have known a hydrocele to contain more than one hundred and twenty ounces. The fluid is generally clear and limpid, and of a straw-colour; but in very large and old hydroceles it may become of a dark-brownish or chocolate hue, owing to the admixture of disintegrated blood; and it will then be found to contain flakes of cholesterine. The sac is usually thin; but in some old cases it becomes thick and dense, lined by a kind of false membrane, and divided by septa or bands, occasionally to such an extent as almost to separate it into distinct compartments. When the sac is thick, and the fluid opaque and turbid, there may be considerable difficulty in detecting the translucency.

The testis is generally somewhat enlarged, especially about the epididymis, and frequently slightly tender, more particularly in the early stages of the complaint. It is almost invariably situated in the posterior part of the sac (Fig. 838), but may sometimes be found towards its anterior part. When this is the case, the epididymis will be found turned towards the front, owing to the organ being retroverted.

The *Coverings* of a hydrocele are the same as those of the testis. Besides the integumental structures, aponeurotic prolongations from the intercolumnar and cremasteric fasciæ may be traced over the surface of the swelling (Fig. 839).

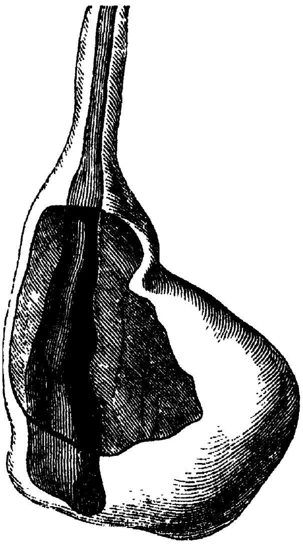


Fig. 838.—Hydrocele of the Tunica Vaginalis laid open.

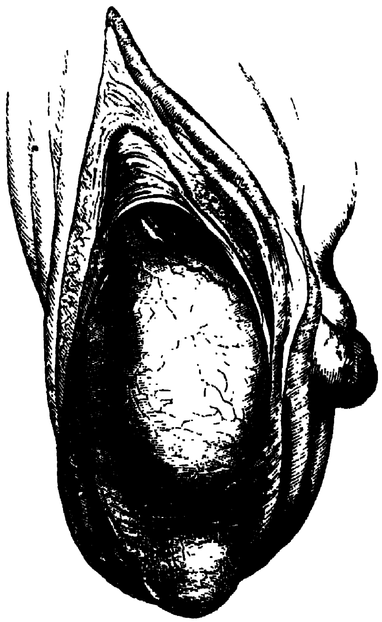


Fig. 839.—Dissection of a Hydrocele, showing its Coverings.

*Treatment.*—The treatment of hydrocele is divided into the *Palliative* and *Curative.* By the *palliative* treatment the Surgeon simply seeks to relieve the patient of the annoyance induced by the bulk or weight of the tumour; but the *curative* has for its object the permanent removal of the disease.

The **Palliative Treatment** consists in the use of a suspensory bandage and cooling lotion, or in tapping with a fine trochar. These simple means, however, will sometimes succeed in effecting a radical cure. Thus, in infants it will happen that the application of evaporating and discutient lotions may remove the effused fluid; and indeed it is seldom that any other plan of treatment than this is required in young children. The best lotion for the purpose consists of one composed of ʒj of muriate of ammonia, ℥j of spirits of wine, and ℥viij of water; with this the scrotum should be kept constantly wetted; and, if there be a communication with the peritoneum, a truss should be kept applied over the external ring. In adults it occasionally happens that simple tapping of the tumour has effected a radical cure. Some years ago, a gentleman from Cuba consulted me for a small hydrocele which had been forming for several months; I tapped it with a fine trochar, and drew off about five ounces of fluid. This was followed by a radical cure. This case bears out a remark made by Brodie, that the few instances in which he had known simple tapping to produce a radical cure occurred in West Indians. I have, however, several times seen hydroceles disappear after having been tapped a few times, without any other treatment, in persons who had never been in hot climates. This simple operation is not altogether, however, destitute of danger;

I have known an old man to die from inflammatory œdema of the scrotum after having been tapped. After tapping, it usually happens that the hydrocele slowly forms again, attaining its former bulk at the end of about three months. Occasionally it will be found that the hydrocele returns more and more slowly after each tapping; so that, by repeating this simple process at intervals of three, then six, then twelve months, the disease will finally disappear. This kind of progressive cure by simple tapping I have several times seen, chiefly in old men. When a congenital hydrocele has been tapped, the sac soon fills again by drainage into it from the peritoneum; and, indeed, in such a case the fluid of an ascites has been drawn off by tapping the tunica vaginalis.

In tapping a hydrocele a few precautions are necessary, the principal being to avoid puncturing one of the scrotal veins, or injuring the testis. In the majority of cases the testis is situated at the back of the tumour, and is consequently altogether out of the way of the trochar, if this be introduced as it should be, by the Surgeon putting the anterior part of the hydrocele on the stretch by grasping it behind with his left hand, and then pushing the trochar into the lower part of its middle third in front, carrying the instrument at first directly backwards (Fig. 840, *a*), but, as soon as it has perforated the sac, directing its point upwards (Fig. 840, *b*). If the testicle have been found, either by pressing the swelling and observing the sensation of pain thus produced in the patient, or on examination with a lighted candle, to be on the fore part of the tumour, where it may sometimes be felt as well as seen, the hydrocele should be tapped at the side or behind. Before using the trochar, it is well to see that the cannula fits closely round the neck of the stylet; and, above all, that the instrument has not become rusty by having been carelessly put aside after use on a previous occasion. As the fluid of the hydrocele escapes, it will sometimes be seen to acquire a pulsatory movement, apparently communicated to it by the arteries of the cord.

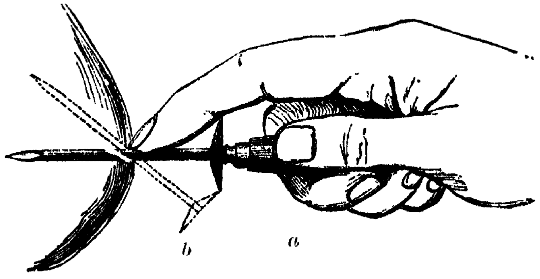


Fig. 840.—Tapping in Hydrocele: *a*, Introduction of Trochar: *b*, Position of Cannula.

The **Curative Treatment** has for its object the excitation of a sufficient degree of inflammation in the tunica vaginalis to restore the lost balance between secretion and absorption; but it is not necessary that the serous cavity should be obliterated by adhesions between its opposite sides, though these not unfrequently take place. The means by which the Surgeon sets up this inflammation are either throwing a stimulating injection into that cavity after tapping it, or the introduction of a small seton into the tunica vaginalis. Whichever plan is adopted, a certain amount of inflammation ought to be set up. This is always attended by considerable swelling of the testis, and by the effusion of a fresh quantity of fluid into the tunica vaginalis. As this is absorbed, the part gradually resumes its normal bulk, and the disease will probably not return.

In order that the radical cure, in whichever way undertaken, should be safe and efficient, it is necessary, in the first instance, that the disease should have been allowed to attain a chronic condition, more particularly if the hydrocele have been of rapid growth. In order to prevent its attaining too large a size, it will be well to adopt palliative tapping once or twice before attempting the radical cure. Care must also be taken to remove all inflammation and tenderness about the testis, before having recourse to this means of treatment. If attention be not paid to this, recurrence of the hydrocele will probably ensue. After the proper amount of inflammation has been set up, it will be well to treat the patient as if he were suffering under an ordinary attack of orchitis, confining him to the bed or to the couch for a few days; indeed, care in the after-treatment is of very considerable importance in securing a favourable result.

The treatment by *Injection* is that which is commonly employed. It consists in tapping the tumour in the usual way, and then throwing a sufficient quantity of stimulating fluid into the tunica vaginalis through the cannula, so as to excite a proper amount of inflammation in it. The liquids that are employed are generally either port wine, or a solution of the sulphate of zinc of the strength of ʒi to ℥xij, or most commonly the tincture of iodine. If the port wine or a solution of the sulphate of zinc be employed, a sufficient quantity partly to distend the sac should be injected from an India-rubber bottle or brass syringe that can be adapted to the cannula; six or eight ounces are commonly required for this purpose, and it should be allowed to remain in for some minutes before being evacuated.

**Injection of Iodine.**—The injection of tincture of iodine, originally introduced by Sir J. R. Martin, whilst practising at Calcutta, is now commonly preferred as a more certain and safer mode of treatment than any other. The quantity of tincture of iodine injected should vary from two drachms to half an ounce, according to the size of the tumour. It may be used pure or diluted with an equal quantity of water. After injection, the Surgeon should rub the scrotum gently over the testis, so as to diffuse the injection equally over the surface of the sac. One half the quantity thrown in should then be allowed to escape, the cannula removed, and the puncture closed with a piece of plaster. The cannula used for this purpose should be made of platinum and not of silver, which is apt to become corroded and made brittle by the action of the iodine. A good deal of inflammation, with fresh effusion into the sac, will usually be set up, on the subsidence of which, the cure will be found to have been effected.

Useful as the iodine injection is, it sometimes fails in producing a radical cure of hydrocele. This is attributable to two causes: the first is, that in some cases sufficient inflammation is not set up to induce that condition of the tunica vaginalis which is necessary for a radical cure. It is well known that, when a hydrocele is radically cured by injection, it is so, not by any adhesion taking place between the two opposite surfaces of the tunica vaginalis and a consequent obliteration of its cavity, but by the inflammation that is artificially induced exciting such a modification of this membrane as to restore the balance between the secretion and absorption of the fluid by which it is naturally lubricated. Now, in some cases, sufficient inflammation is not induced by the introduction of the irritating fluid to restore the natural balance between these two functions of the membrane ; and the tunica vaginalis gradually fills again after the injection, as it would after the simple operation of tapping. It occasionally happens that the patient may suffer excruciating agony at the time of the injection, from the contact of the stimulating fluid with the surface of the testis, and yet little or no inflammation may be excited. The amount of suffering, therefore, at the time of the operation is by no means proportionate to the amount of consecutive inflammation likely to be set up. Indeed, the reverse would appear to be the case in many instances ; and I have often observed that, in those cases which progress most steadily to a radical cure, there is but a moderate amount of pain experienced at the time of the injection.

There is a second way in which injections would appear to fail ; a considerable amount of inflammation is excited, and effusion takes place into the tunica vaginalis, which in the course of three or four days becomes distended to the same size, or nearly so, that it had attained previously to the operation ; but this effused fluid, instead of being absorbed by the end of the second or third week, remains unchanged in bulk, or absorption goes on to a certain point, and then seems to be arrested ; the tunica vaginalis remaining distended with a certain quantity of fluid.

A third way in which the failure arises, is in consequence of the walls of the sac being so thickened that they cannot collapse.

The proportion of cases in which the iodine injection fails to bring about a radical cure of the hydrocele is variously estimated by different Surgeons. Thus Sir J. R. Martin states that in India the failures scarcely amount to 1 per cent. ; Velpeau calculates them at 3 per cent. I am not aware that any statistics of this mode of treatment in this country have been collected ; but the general opinion of Surgeons would appear to be decidedly in its favour, as being the most successful as well as the safest plan of treatment that has yet been introduced. In this opinion I fully coincide : yet it is by no means improbable that the success of the iodine injection in this country might not prove to be quite so great as is generally believed. I have seen a considerable number of cases of simple hydrocele of the tunica vaginalis, both in hospital and in private practice, in which a radical cure had not been effected, although recourse had been had to the iodine injection by some of the most careful and skilful Surgeons of the day, as well as by myself. It is especially apt to fail in men advanced in years. In them there is either not sufficient inflammation excited, or if it be, the fluid that is as a consequence effused into the tunica vaginalis is not re-absorbed.

One circumstance connected with the injection of tincture of iodine into the tunica vaginalis deserves note. It is that, although in some cases it occasions but little pain, in other instances the suffering induced by it is of the most severe and agonising character—more so than follows the introduction of any other of the ordinary stimulants into the tunica vaginalis.

**Seton.**—The cure by the introduction of a seton, though formerly much employed, is seldom practised at the present day, chiefly on account of the danger of exciting too much inflammation. It may, however, conveniently be employed in the true hydroceles of children, and in some of those cases in which the injection fails, if practised in the manner that will immediately be described. There can be no doubt that, as a first remedy, iodine injection is preferable to the seton, in the treatment of hydrocele ; but when the injection has failed, and this from no want of care on the part of the Surgeon, or of attention to the after-treatment of the case, but apparently from insufficient inflammatory action having been set up in the tunica vaginalis to restore the lost balance between secretion and absorption in this membrane, the seton will, I think, be found to be the most certain means of accomplishing our object. It is true that several objections may be urged to the use of the seton ; it requires much watching and care, and is occasionally apt to excite a dangerous amount of inflammation in the areolar tissue of the scrotum ; and these objections are, to my mind, sufficiently valid to prevent our employing it as the ordinary treatment for the radical cure of hydrocele. But it must be remembered, that the particular cases to which I am now alluding are those in which ordinary means have proved insufficient to excite proper action, and in which, consequently, it would appear as if a greater amount of irritation could safely be borne. Indeed, nothing is more remarkable than the difference in the intensity of the inflammation that is set up in different individuals by the means that are commonly employed in the treatment of hydrocele. In some cases the most irritating injections may be thrown into the tunica vaginalis, or a seton may be drawn through the scrotum and left there for days, not only without giving rise to any injurious inflammation, but without setting up sufficient action to bring about a cure of the disease ; whilst in other instances simple tapping may effect a radical cure, or may give rise to such an amount of irritation as to terminate in a fatal sloughing of the scrotum.

The seton that I employ in these cases is composed of one or two threads of dentist's silk. It may be introduced by means of a nævus needle, the fluid of the hydrocele being allowed to drain away through the punctures thus made ; or, far better, by tapping the hydrocele, and then passing a needle about six inches long, armed with the seton, up the cannula, drawing it through the upper part of the scrotum, and then removing the cannula, cutting off the needle, and knotting the thread loosely (Fig. 77, p. 158, Vol. I.). The thread should not be removed until the scrotum swells and becomes red, with some tenderness of the testis and effusion into the tunica vaginalis. When these effects have been produced, it may be cut and withdrawn, and the case treated in the same way as when the radical cure has been attempted by iodine injection ; viz., by rest and antiphlogistic treatment. The length of time during which the seton must be left in before sufficient, or even any inflammatory action is produced, varies very considerably. In most instances, the proper amount of inflammation is excited in from twenty-four to thirty hours ; but in other cases the seton may be left in for ten or twelve days, giving rise to but little inflammation, although a radical cure may result.

The **Antiseptic Method** has been successfully applied to the treatment of hydrocele by Volkmann, and Reyher of Dorpat. The sac is incised along its anterior aspect, the fluid evacuated, and the parts dressed antiseptically. This treatment is said to be more certain and less painful than that by injection. It would be especially useful in old cases with thickened walls in which the injection had failed.

It is not always prudent to have recourse to the radical cure in the treatment of hydrocele. In persons advanced in years, or of feeble and unhealthy constitution, the inflammatory action excited in the tunica vaginalis by any of the means just detailed may run on to such an extent as to give rise to inflammatory œdema, and even sloughing of the scrotum, with great danger to life. In men advanced in years it is much safer and usually sufficient to temporise with the hydrocele, and only to tap as occasion arises from the increasing size of the swelling.

ENCYSTED HYDROCELE.—In this variety of the disease the fluid does not lie in the tunica vaginalis, but is contained in a cyst which projects from the surface of the epididymis or testis, and pushes the serous investment of the gland before it.

These cysts are much more frequently found connected with the epididymis than with the body of the testicle. Indeed, Curling has pointed out the fact, that small pedunculated cysts about the size of currants, and composed of a fine serous membrane, lined with tesselated epithelium, are very frequently found beneath the visceral tunica vaginalis covering the epididymis. They are delicate in structure, contain a clear limpid fluid, and are very liable to rupture. They are met with at all ages after that of puberty. According to Gosselin, after the age of forty, they occurred in at least two thirds of the testes examined to ascertain their presence. Such cysts as these may remain stationary, of small size, and not to be detected during life, being merely pathological phenomena; they may rupture into the tunica vaginalis; or they may enlarge and become developed into tumours of considerable magnitude.

The fluid of these cysts possesses the remarkable characteristic discovered by Liston, of containing spermatozoa (Fig. 841); an observation that has been fully confirmed by many subsequent observers. Though spermatozoa do not always exist in this fluid, yet they are usually met with, sometimes in small quantities, at others so abundantly as to give it a turbid or opalescent appearance. This admixture of spermatozoa with the clear fluid of the cyst is probably due, as pointed out by Curling, to the accidental rupture of a seminal duct into an already existing cyst. Spermatozoa have also, but very rarely, been found in the fluid of an ordinary hydrocele of the tunica vaginalis; and then probably their presence was due to the rupture of one of these cysts into the tunica vaginalis. Hence their presence in the fluid of hydrocele may in most cases be considered as characteristic of the encysted variety of the disease.

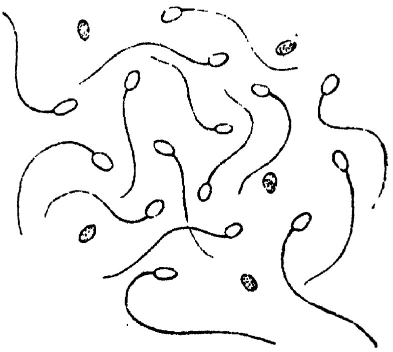


Fig. 841.—Spermatozoa from Encysted Hydrocele.

There are two distinct forms of encysted hydrocele; in one the disease is due to dilatation of a seminal duct; in the other, to a new cystic formation. The first form alone contains spermatozoa.

The *Signs* of encysted hydrocele differ in some respects from those presented by the ordinary form of the disease.

The tumour of the encysted variety is smaller, more irregular in shape, and does not envelop the testis completely, but is situated behind it, and rather in connection with the epididymis.

The *Diagnosis* from ordinary hydrocele of the tunica vaginalis may be made by observing: 1. That the testis is below and not covered in by the encysted form of the disease; 2. That the tumour is more globular or irregular, and less pyriform; 3. When tapped, the fluid will be found to be opalescent.

The *Treatment* consists in injecting the sac with tincture of iodine, or in incising the tumour and allowing it to granulate from the bottom. The injection by iodine, though successful in some cases, is not so frequently so in this as in the last variety of the disease, but usually deserves a trial; if it fail, the incision of the tumour will always effect a cure.

In encysted hydrocele, the iodine injection should not be so strong as that which is used for injecting the tunica vaginalis. It should be diluted with two or three parts of water, as it comes more directly into relation with the structure of the testis.

HYDROCELE OF THE CORD.—This disease is characterised by the presence of a round or oval tumour, situated on the cord, below or within the inguinal canal. It is smooth, elastic, and, if of sufficient size, may be semi-transparent on examination by transmitted light. It can be pushed up into the abdomen, but receives no impulse on coughing, and does not alter in size on being steadily compressed. It appears to be formed, in some cases, by the funicular portion of the peritoneal investment of the cord being imperfectly closed and consolidated at points; though it is possible that in other instances it arises as a distinct cystic growth. These tumours may occur at all ages, but are chiefly met with in the young, and are not unfrequent amongst children.

The fluid of a hydrocele of the cord is lighter in colour than that of one of the tunica vaginalis.

*Treatment.*—The obliteration of the cyst is best conducted by passing a seton through it, or by making an incision into it, treating it antiseptically, and letting it granulate from the bottom.

DIFFUSED HYDROCELE OF THE SPERMATIC CORD consists in the infiltration of the cord with serous fluid, contained in rather distinct cells, and giving rise to an oval or oblong irregular circumscribed tumour, extending below and into the inguinal canal.

The *Treatment* consists in the application of blisters, or of counter-irritant plasters. Should the disease prove very troublesome, an incision might be made down to and into the swelling, so as to let out the fluid and allow the cyst to become consolidated.

HÆMATOCELE.—By *Hæmatocele* is meant an accumulation of blood in the tunica vaginalis, distending that sac, and compressing the testis. It is of two kinds, *Traumatic* and *Spontaneous*. The *Traumatic* is the most common form of the disease, usually arising from a blow on or a squeeze of the testis, by which one of the veins ramifying on the surface of the gland is ruptured, and blood is poured into the tunica vaginalis. It may also arise in tapping a hydrocele, from the point of the trochar being pushed too directly backwards and puncturing the testis. *Spontaneous Hæmatocele* is a disease of rare occurrence, arising apparently from the rupture of an enlarged spermatic vein into the tunica vaginalis. It attains a larger size, and is altogether a more formidable affection, than the traumatic hæmatocele.

*Characters.*—In whatever way occurring, a hæmatocele slowly but gradually increases in size until it attains about the magnitude of a duck's egg, or even that of a cocoa-nut. It is seldom that it becomes larger than this; but cases are recorded in which the tumour has attained an enormous magnitude. I once operated in a case in which a spontaneous hæmatocele had existed for six years; it was as large as a good-sized melon, and contained, besides about a quart of dark thin blood, a handful of partially decolorised and tough fibrine, the greater portion of which was firmly adherent to the inside of the greatly thickened tunica vaginalis in filamentary and laminated masses, with here and there nodules interspersed. The whole of the interior of the tunica vaginalis closely resembled an aneurismal sac.

The fluid contained in the hæmatocele, when the disease is recent, consists of pure blood. The blood so effused will continue fluid for years; but at last it may decompose and set up fatal inflammatory mischief; in some rare instances the tumour becomes partly solidified by the deposit of masses of fibrinous coagulum lining the interior of the tunica vaginalis, which are sometimes decolorised and arranged, as in the case just referred to, and in one recorded by Bowman, in a laminated manner, like the contents of an aneurismal sac. When the hæmatocele is of old standing, changes take place both in the effused blood and in the sac. The blood in old hæmatoceles becomes at first dark and treacly. As decomposition advances it becomes converted into a dirty-brownish fluid, full of shreds of partially decolorised fibrine and crystals of cholesterine. The tunica vaginalis becomes thickened and indurated, and in extreme cases may undergo calcification. This change I found in a patient whose disorganised testis I removed for a hæmatocele of nearly forty years' standing.

*Symptoms.*—These are generally sufficiently obvious. The occurrence of the tumour subsequently to a blow, strain, or injury when traumatic, its gradual increase in size, its somewhat heavy but semi-elastic feel, its pyriform shape, and the absence of transparency, together with the freedom of the cord above and the want of impulse in it on coughing, will indicate its true character.

*Diagnosis.*—Hæmatocele of the tunica vaginalis may be confounded with inguinal hernia: from which it may be distinguished by attention to the signs described at p. 660, Vol. II. It is perhaps more frequently confounded with solid tumours of the testicle; and upon this fact is founded the excellent rule of practice never to remove a doubtful tumour of the testis without first ascertaining, by an incision into its substance, that it is not a hæmatocele.

*Treatment.*—This must vary with the size and duration of the tumour. When it is small and recent, and has fluid contents, the Surgeon may try the effect of tapping it; it is possible that, after the evacuation of the blood, closure and obliteration of the tunica vaginalis will take place. This happened in a case under my care, in which, though the disease had existed for three years, a complete cure followed the operation of tapping. Such simple treatment as this, however, cannot be depended upon; and it usually becomes necessary to lay the sac open, treat the wound antiseptically, and to cause it to contract and to granulate from the bottom, when the obliteration of the cavity of the tunica vaginalis necessarily results. If the tumour were of very large size, and the tunica vaginalis much thickened, hardened, and parchment-like, with adherent and laminated fibrine, castration might possibly be required. In the instance to which I have already referred, and which is represented in Fig. 842, this was rendered necessary in consequence of these conditions, and was successfully done.

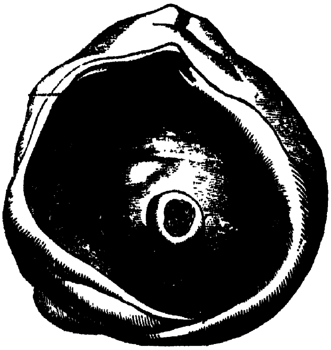


Fig. 842.—Hæmatocele with Thickened Tunica Vaginalis and adherent Fibrinous Deposit.

**Hæmatocele of the Spermatic Cord** has been observed by Pott, Curling, Bowman, and others; it is a rare disease, and usually occurs in the form of tumour of considerable magnitude, suddenly arising after a strain or some violent exertion, giving rise to a rupture of a varicose spermatic vein. It commences in the inguinal canal, and thence extends downwards along the course of the cord, through the abdominal ring into the scrotum; but it does not surround or implicate the testis, which can be felt free and movable at its lowest part. On incising such a tumour as this, a quantity of blood, partly fluid and partly coagulated, has been found, sometimes contained in a cavity, occasioned by the laceration and separation of the tissues of the cord and scrotum. The most remarkable case of this kind on record is one related by Bowman, in which the tumour, after existing for ten years, had attained so enormous a size, that it reached to the patella, and was so heavy as to require both hands and a considerable effort to raise it from its bed. In this case, death appears to have resulted from decomposition of the contents of the tumour.

*Diagnosis.*—In its early stages, hæmatocele of the cord would run considerable risk of being confounded with an *inguinal hernia.* The more diffused character of the swelling, however, its regular feel, its semi-fluctuating sensation, and the impossibility of reduction, might enable the diagnosis to be made (p. 659, Vol. II.). Hæmatocele of the cord may always be distinguished from an accumulation of *blood in the tunica vaginalis,* by the testicle not being implicated in the former case, but surrounded by the fluid in the latter instance.

The *Treatment* of this disease must in the earlier stages be of a palliative kind; consisting in rest, support of the tumour, and the application of evaporating lotions. Care should be taken not to incise it at this period, lest the loss of blood from the ruptured vein, after the evacution of the contents of the tumour, become uncontrollable. In one instance I have known fatal consequences from this cause to ensue in half an hour after making an incision into the tumour and turning out the coagula. When, however, the disease has reached a chronic stage, and is no longer increasing, it may be incised; and, its contents being turned out, the cavity may be allowed to suppurate and granulate.

### VARICOCELE.

*Varix,* or *Enlargement of the Spermatic Veins,* is a disease that is commonly met with from the age of puberty to about the thirtieth year, seldom commencing later than this. It usually occurs in feeble individuals having the scrotum lax and pendulous; and in some cases appears to have been brought on by venereal excesses. The spermatic veins, extending as they do from opposite the lumbar vertebræ to the plexus pampiniformis, which constitutes the base of the pyramidal tumour formed by a fully developed varicocele, are necessarily subject to considerable outward pressure from the weight of so long a column of blood as that contained within them, to which they eventually yield, becoming much dilated and tortuous. The left spermatic veins are far more frequently affected than the right; partly owing to their compression by feculent accumulations in the sigmoid flexure of the colon, and partly to the obstacle at the mouth, occasioned by their pouring their contents into the left renal vein, at right angles to the current of blood flowing through that vessel into the vena cava. The right spermatic veins are rarely affected; and never, I believe, without those on the left side participating in the disease. In these cases of double varicocele, the left is almost invariably the more seriously affected; but I have seen exceptions to this in one or two instances, in which the veins on the right side formed the larger tumour.

SYMPTOMS.—The symptoms of varicocele consist of a tumour of pyramidal shape, having a knotted or knobbed feel, owing to the irregularly swollen and convoluted condition of the veins, with its base upon the testis and the apex stretching up to the external ring. The swelling increases when the patient stands up, if he take a deep inspiration, cough, or make any violent exertion. Its size varies from slight fulness of the veins to a large mass, several inches in circumference at the base. When the patient lies down, it goes up to a certain extent, but immediately returns to its former magnitude when he stands up again. It is attended by a sensation of weight and sometimes of pain, which is occasionally very acute, of a severe and neuralgic character, even in the scrotum, the groins, and the loins, more particularly when the tumour is unsupported. This pain is greatly increased on the patient walking or riding; so much so, that in some cases he is almost debarred from taking necessary exercise, and is prevented from following any active occupation. Debility of the generative organs, with a tendency to seminal emissions and much mental depression, frequently accompanies varicocele. The rupture of a varicocele may occur from external injury, giving rise to an enormous extravasation of blood into the areolar tissue of the scrotum. Of this Pott relates a case. In one, I have known this to be attended with fatal consequences. A man who, to use his own expression, "had been romping with his wife," received a blow on a varicocele, when an enormous extravasation of blood rapidly formed in the scrotum and the cord, for which he was admitted into the Hospital. The tumour was incised, and, large masses of coagula having been turned out, the patient, in the absence of assistance, suddenly became faint and died of venous hæmorrhage. The bleeding was found to have proceeded from a ruptured spermatic vein.

DIAGNOSIS.—The diagnosis of varicocele is always sufficiently easy; its peculiar feel, its broad base and narrow apex, the manner in which it goes up when the patient lies down, and returns again when he stands up, are sufficient to distinguish it from all other scrotal tumours. From *inguinal hernia* the disease may be distinguished by attention to the test described at p. 660, Vol. II.

TREATMENT.—The treatment of varicocele must be conducted with reference to the severity of the symptoms occasioned by it, and to the extent of the disease. When, as is usually the case, it gives rise to but slight inconvenience, palliative treatment is fully sufficient; but if, as occasionally happens, the disease be a source of very intense suffering, or tend to the induction of atrophy of the testis, or to generative debility, with much mental disquietude or hypochondriasis, then the Surgeon may feel disposed to endeavour to cure the varicocele radically.

The *Palliative Treatment* of varicocele resolves itself into means of various kinds, having for their object the support of the testis and the diminution of the length, and of the consequent pressure, of the column of blood. This is usually most conveniently done by supporting the scrotum in a well-made suspensory bandage; or pressure may be made upon the part, as well as support given, by enclosing the testis in an elastic bag. In other cases, support may be afforded by drawing the lower portion of the scrotum on the affected side through a ring made of soft metal, covered with leather, or better still, through a small vulcanised India-rubber ring, so as to shorten the cord. And, with the same object, excision of the lower portion of the scrotum has been recommended; so that, by the contraction of the cicatrix, the testis may be pressed up against the ring, and the cord thus shortened. This plan, however, is somewhat severe; and though it might be attended by temporary benefit, the advantage accruing is not likely to be very continuous. The pressure of the pad of a truss on the spermatic cord, as it issues from the external ring, will break the length of the column of blood in its veins, and may thus be of service in some cases, though many patients cannot bear the irksome pressure of the instrument.

In addition to these mechanical means, the part may be braced by cold douching, sea-bathing, and the general strength improved by the administration of iron.

The **Radical Cure of Varicocele** consists in the obliteration of the enlarged veins by compressing and exciting inflammation in them, on the same principle that guides us in the management of varix in other situations.

The circumstances for which operation may be and has been practised in this disease can be arranged in the following categories.

1. When the existence of a varicocele disqualifies the sufferer from admission into the public services, there is, in my opinion, a perfectly legitimate reason for operating. One of the cases in which I have effected a radical cure was that of a man in the prime of life, who, wishing to enlist in the Marines, was refused solely on the ground of having a small varicocele. This I cured by operation, and the man afterwards entered the service.

2. In some cases, the presence of a varicocele of inordinate size causes a distressing sense of weight and pain in the loins and groins, and often inability to stand or walk for any length of time. Here, when the patient is in continual discomfort, or more or less prevented from pursuing his ordinary avocations—in fact, quite crippled—it is perfectly justifiable to resort to operation.

3. When atrophy of the testicle is a consequence of the pressure of the blood in the veins, an operation may be performed.

4. Cases not uncommonly occur where the pressure of the enlarged veins on the spermatic nerves produces repeated attacks of spermatorrhœa. These cases are, however, more frequently met with out of hospitals, than in individuals of the class who apply to such institutions for relief. In fact, young men of the more highly educated classes are very subject to varicocele, especially those who habitually lead a sedentary and studious life, as, for instance, young clergymen and lawyers. In these persons, a peculiarly hypochondriacal state is brought on by the tendency of the mind to dwell on the condition of the genital organs, and the patient is constantly fidgeting about the local and tangible disease he observes in them.

How should the radical cure of this condition be produced? To this I would answer—By exciting adhesive inflammation of the spermatic veins, through an application of the same principle which sets up that process in the veins of the lower extremity. There are several different ways of doing this; some are very objectionable. The twisted suture, as applied to the veins of the leg, induces too great irritation in the scrotum, and there its introduction is often followed by violent inflammation or sloughing, or by an opening up of the areolar tissue of the scrotum with œdema, and even purulent infiltration. It is better, I think, not to use this method here; indeed I have twice, in the practice of others, seen it followed by death. The plan I have adopted for some years is that suggested and practised by Vidal de Cassis, and is as follows.

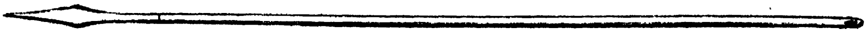


Fig. 843.—Iron Pin for Treatment of Varicocele.

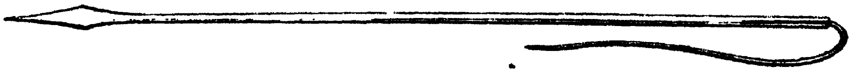


Fig. 844.—Needle threaded with Silver Wire.

The vas deferens, readily distinguished by its round cord-like feel, is first separated from the veins, and entrusted to an assistant; next, an iron pin bored with a hole at each end (Fig. 843), is passed between the vas and the veins, and brought out at the point of perforation, the scrotum being first notched with a scalpel; then a silver wire, threaded on a needle so constructed that the wire shall follow it without catching (Fig. 844), is passed in at the aperture of entry of the pin, and carried between the integument of the scrotum and

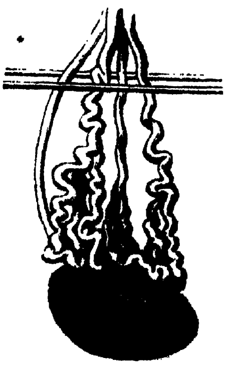


Fig. 845.—Vidal's Operation for Varicocele: Needles and Wire applied.

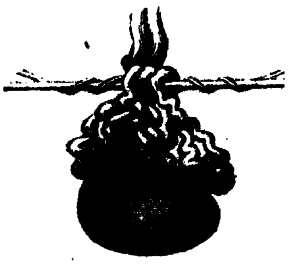


Fig. 846.—Wire Twisted and Veins Rolled up.

the veins, the wire being brought out at the second puncture (Fig. 845). Each end of the wire is now passed through the corresponding hole of the pin, which is twisted round and round repeatedly, each turn causing the wire to be rolled around the pin, and so tightened, till the veins are firmly compressed between the pin behind and the loop of wire in front (Fig. 846). By this means the scrotum is quite free and uncompressed, and there is no danger of exciting inflammation or œdema. The wire should be tightened from day to day, as it causes ulceration in the veins until it has completely cut through, which results, usually, in about a week or ten days. Meanwhile, there is much plastic matter thrown out around the veins ; this finally contracts and obliterates their channels. This method produces an effectual and permanent cure (Fig. 847).

Fig. 847.—Vidal's Operation : Appearance of Needle and Wire when removed.

Of late, I have been in the habit of employing a simpler method. I separate the vas deferens in the usual way, and then make a small incision, about half an inch long, in the front and back of the scrotum : afterwards I pass a needle armed with silver wire, as before described, between the vas and the veins, bringing it out behind ; I then return the needle, but this time carrying it in front, between the veins and the skin ; and thus the veins are included in a loop of wire, without implicating the scrotum. The loop is then tightly twisted together, so as to constrict the enclosed vessels. This plan has a similar effect to that of the wire and pin combined ; by repeated tightenings the wire gradually effects a passage by ulceration through the veins, which are obliterated by the same process.

It has been objected to this and similar operations, that atrophy of the testis may take place, from its arterial branches being included together with the veins ; but, as the spermatic artery runs near to the vas deferens, and is held out of the way with that duct, it escapes, and the chance of that mischief is avoided. Nevertheless, atrophy of the testis may coexist, as the result of long-continued pressure of the blood in the vessels of the gland before the performance of the operation.

## TUMOURS OF THE TESTIS.

All solid tumours of the testicle are classed together under the generic term of **Sarcocele** ; and, when these are conjoined with fluid accumulations in the tunica vaginalis, they are termed **Hydro-sarcocele.** Sarcocele is usually divided into the *Simple*, the *Syphilitic*, the *Tuberculous*, the *Cystic*, and the *Malignant* ; which, indeed, comprise so many distinct diseases of the testis, requiring separate study.

SIMPLE SARCOCELE is a chronic enlargement of the testis resulting from inflammatory mischief in the organ, not arising from syphilis or deposit of tubercle. It is, in fact, chronic orchitis. Both the epididymis and the body of the gland are usually affected. The testicle feels hard, smooth, solid, though perhaps slightly elastic at points ; it is ovoid in shape, and usually about as large as a duck's egg. It is heavy and but slightly painful, and, except in very old cases, the peculiar sensation felt on squeezing a testicle is present. The cord is usually somewhat thickened, and, as well as the groin, is the seat of pain of a dragging character. The tunica vaginalis occasionally contains serous fluid lying in front of and obscuring the testis, constituting the condition spoken of as hydro-sarcocele. The scrotum is always healthy, and one testicle only is usually affected. Occasionally simple chronic inflammation may slowly give rise to suppuration, and one or more abscesses may form, especially in strumous subjects. In these circumstances, a part of the indurated testicle softens and becomes prominent, the skin becomes red, shining and thinned, and adhesions form between it and the gland beneath. At last the abscess bursts and a fistulous opening is left. Through this aperture a fungus (hernia testis, or benign fungus of the testicle) speedily protrudes, which grows sometimes slowly, sometimes rapidly, perhaps attaining a very considerable size (Fig. 848). As the fungus increases, the organ appears to atrophy, but in reality is drawn out of the scrotum and merges into the fungus. This fungus is not a new growth, but is a granular mass composed essentially of the tubuli testis and inflammatory products. It is in the form of a pale reddish-yellow granular mass. If small and firm, it may become a very chronic complaint; but if large, rapidly growing, and loose-textured, it speedily destroys the secreting structure of the testis, leaving nothing in the scrotum but a thickened epididymis and a contracted and shrunken tunica albuginea. It is, however, surprising how long the functions of this organ will continue, though its tissue is in a great measure destroyed, and its structure traversed by suppurating fistulæ. Occasionally, instead of bursting and giving rise to fungus, the abscess may become surrounded by dense fibroid tissue and remain stationary, and this dense wall has been known to calcify.

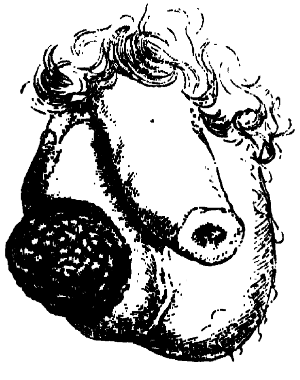


Fig. 848.—Hernia Testis or Benign Fungus of the Testicle.

Simple chronic orchitis can usually be distinctly attributed to a blow, squeeze, or other injury by which inflammation has been excited in the organ.

*Structure.*—On making a section of a testicle affected with simple chronic inflammation, the tunica vaginalis will be found to be more or less adherent, and perhaps separated from the tunica albuginea in parts by small collections of fluid. The tunica albuginea is thickened, often presenting on its external surface a series of firm, glistening layers. The septa of the testis are seen to be thickened, rendering the whole organ hard and firm, and giving it a bluish-grey appearance. In the midst of this, soft opaque yellow spots may be seen. These have been mistaken for tubercle, but are in reality masses of chronic inflammatory products that have undergone fatty degeneration. The microscope shows that the chronic inflammation chiefly affects the intertubular fibrous tissue, but in many cases this is accompanied by catarrhal overgrowth of the epithelium.

*Prognosis.*—Simple chronic orchitis usually terminates in recovery, but the organ may be left somewhat enlarged and indurated, or in other cases it may undergo atrophy as the inflammatory products become absorbed.

*Treatment.*—Strapping and the administration of an alterative course of bichloride of mercury may be tried. If the organ do not diminish in size by these means, or if it be a source of much inconvenience to the patient, it must be removed. If accompanied by hydrocele the hydrocele must be tapped, but on no account should injection of iodine be resorted to. If abscesses form, they must be opened. When a fungus has protruded through one of the fistulous apertures, means must be taken to repress or remove this, lest it go on to complete destruction of the testis. If it be of small size, the best plan will be to sprinkle it with red oxide of mercury, and to strap it tightly down with a piece of lint and strapping. If it be larger, it may be shaved off, and the cut surface then dressed with the ointment of the red oxide of mercury ; care being taken during cicatrisation to repress the granulations below the level of the surrounding integument by strapping and pressure. Syme has recommended that the pressure should be effected by the integument of the part ; an elliptical incision being made round the fungus and the edges of the opening in the skin through which it protrudes pared away, the scrotal integuments are freely separated by dissection from their subjacent connexions, and brought together over the protruding mass and secured by sutures. This operation I have practised with success. Should the fungus be of very large size, so as to include within itself the whole or greater part of the structure of the testis, it may not be possible to save any of that organ ; and in these circumstances it is better to remove the whole gland ; if left it could never be of any service, and would continue slowly to suppurate.

TUBERCULAR TESTICLE, SCROFULOUS TESTICLE, OR TUBERCULAR SARCOCELE.—This disease, although occasionally met with in individuals apparently strong and healthy, usually occurs in those of a feeble or cachectic constitution, most frequently in early manhood ; and, although commonly associated with phthisis, may occur without any evidence of tubercularisation in other organs. It is very common to find both glands affected, but the disease is usually more advanced in one than in the other. In some cases it arises apparently as a sequence of gonorrhœal epididymitis, or there may be a history of some injury to the testicle. The disease almost invariably commences in the epididymis, either at the globus major or minor, which becomes swollen, indurated, and slightly tender. As it progresses, it spreads upwards along the vas deferens until it may reach the prostate and vesiculæ seminales, and forwards through the corpus Highmorianum into the body of the testis. In some rare cases, it is said to commence in the body of the gland. The progress of the disease is usually slow, but it may go on rapidly to almost complete destruction of the testis. In a well marked case the following conditions will be found. The testicle is moderately enlarged, but on examination this enlargement will be found to be chiefly in the epididymis, which can be felt as an irregular, craggy, nodulated mass, half surrounding the body of the gland in the form of a crescent situated at its posterior aspect. In the hard mass, which often considerably exceeds the body of the gland in bulk, spots of softening may be felt. The gland itself may feel soft and natural, or a nodule or two may be felt in its substance. The affection is scarcely ever complicated by hydrocele, and in the earlier stages the scrotum is unaffected. The spermatic cord will usually present no general thickening, but the vas deferens is enlarged. Instead of feeling like a piece of whipcord between the fingers, it may be as large as a quill. If the disease have extended to the vesiculæ seminales, these can be felt enlarged and hardened by introducing the finger into the rectum. There is little or no pain, and on squeezing the gland the ordinary sensations will be perceived by the patient except in a very advanced stage of the disease. As the disease advances, one of the craggy nodules softens, and the skin becomes adherent over it. This process is accompanied by more acute inflammation, usually causing marked increase of pain and tenderness. The adherent skin becomes red and shining, and finally gives way, and the tuberculous abscess discharges itself, leaving an unhealthy cavity yielding thin pus mixed with soft, shreddy whitish-yellow sloughs. In some favourable cases the cavity may granulate and close completely, or leave merely a fistulous opening discharging small quantities of serous fluid. In most cases, however, the process of softening extends, other nodules break down, and a great part of the testicle may be destroyed. If an abscess should form in the body of the gland, a hernia or fungus testis may follow, as in simple chronic orchitis. Occasionally exuberant granulations may sprout out from the region of the epididymis, closely resembling the true fungus testis. The general health suffers greatly, and at a comparatively early stage of the case tubercular disease of the lungs is almost certain to make its appearance. In the great majority of cases, the opposite testicle also becomes affected. Death usually results from the disease of the lungs, but it may occur from acute general tuberculosis with tubercular meningitis. Occasionally the disease may extend to the urinary tract, and terminate fatally from tubercular disease of the kidneys.

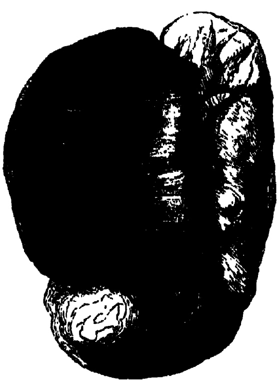


Fig. 849.—Tubercular Testicle, showing the diseased Epididymis forming a crescentic mass partially surrounding the healthy body.

In some cases of phthisis, in which the testicles enlarge, and yet give but little trouble, the whole organ, both body and epididymis, may be found converted into a uniform soft cheesy mass. A specimen of two such testicles, from a patient who died from disease of the lungs, is in the Museum of University College. In cases of acute general tuberculosis, grey granulations have been found in the testicles.

*Structure.*—On making a section from before backwards through a typical specimen of tubercular disease of the testicle, the following conditions will be found. The tunica vaginalis may be perfectly healthy, or may be here and there adherent to the tunica albuginea. The tunica albuginea will be normal in appearance, except in the immediate neighbourhood of a tubercular growth, where it will be thickened. That part of the body of the gland nearest the surface may be perfectly healthy in appearance; there is no thickening of the septa, and the tubules can be teased out under water as in a healthy testicle. As we approach the corpus Highmorianum, the gland becomes studded with small hard nodules, not growing in the septa, but in the glandular substance of the testis. In their earliest stage these are merely hard semi-transparent granulations ; but they soon show signs of undergoing fatty degeneration in the centre, so that the majority have the appearance of small bodies about the size of a millet-seed, having a yellow opaque centre, and a delicate greyish semi-transparent growing margin. Still nearer the corpus Highmorianum these yellow spots coalesce, and form a solid cheesy substance, continuous with a still larger mass of the same kind, which represents the epididymis, and half surrounds the body of the gland in the shape of a crescent. In this larger mass patches of softening are found forming the tubercular abscesses above described, and these may extend into the body of the gland. On making transverse sections of the vas deferens, its walls will be seen to be thickened, and its centre filled up with a yellow cheesy material. If the disease be further advanced, the whole gland may be converted into a single cheesy mass, in which softening may be taking place at various parts.

The exact nature of the change that takes place in the production of the condition above described, has given rise to much difference of opinion ; some authors maintaining that the primary change consists in an overgrowth of the epithelium of the tubuli seminiferi and epididymis, which afterwards undergoes fatty degeneration ; and others asserting that the primary growth takes place between the tubuli, and that the changes in the epithelium are secondary.

The accompanying drawing (Fig. 850) represents a section of one of the small outlying nodules in the body of the gland, as described above. It will be seen that the change chiefly consists in an accumulation of small round cells in a more or less perfect reticulate stroma between the tubules, separating them from each other. At the same time the walls of the tubules have undergone a change, being infiltrated with cells in the same way as the sur-

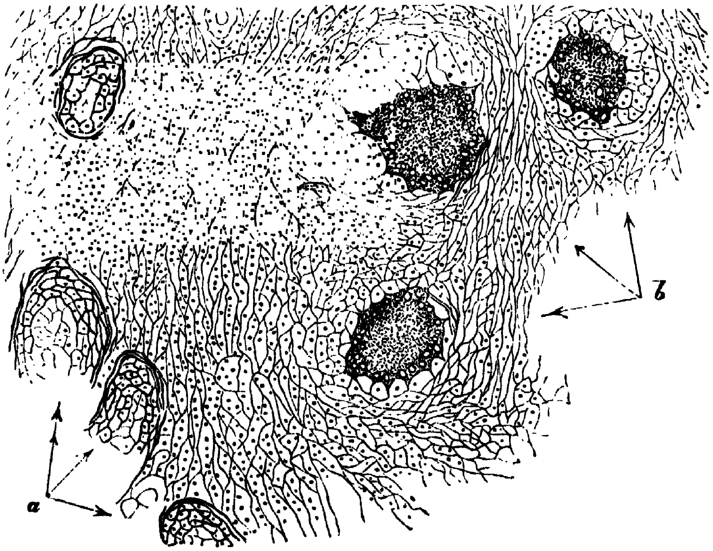


Fig. 850.—Tubercular Testis. *a.* Tubuli seminiferi ; *b.* Giant-cells (40 diam.).

rounding parts. The tubules also are choked with epithelium, which in some parts of the same testicle was found to be undergoing fatty degeneration. Towards the centre of the nodule the intertubular growth also becomes caseous. Scattered through the new growth are many large masses of protoplasm containing many nuclei, the so-called giant-cells. These are not constantly present in cases of tubercular testis. It is most probable, therefore, that the change commences in the lymphatic tissue in the walls of the ducts of the epididymis and between the tubuli seminiferi, and gives rise to secondary proliferation of the epithelium; both the intertubular growth and the proliferated epithelium afterwards undergoing fatty degeneration, and forming cheesy masses.

*Prognosis.*—The prognosis of tubercular disease of the testis is extremely bad. Treatment is of little if any avail, and the patient almost invariably dies sooner or later of disease of the lungs, from general acute tuberculosis, or from extension of the disease to the bladder, prostate, and even, in rare cases, the kidneys. In some cases, however, after the abscesses have burst, the cavities may heal, and the testicle remain withered, but free from active disease.

*Treatment.*—The treatment of tubercular testis must be conducted on general principles; alteratives, tonics, especially the iodide of iron, with cod-liver oil, and general hygienic means calculated to improve the health, must be steadily persevered in for some length of time. Local applications are of little avail. The abscesses must be opened when they form, and some simple dressing applied. If fungus form, it is of little use to try to treat it by the methods before described, as if the body of the testis be deeply infiltrated with tubercle, no good could result. If the gland give much trouble to the patient, and if there be at the same time no very marked constitutional affection, and the lungs be not in a state of very active disease, the operation of castration is perfectly justifiable; although in most cases it is at best only calculated to give the patient temporary relief, as the disease usually extends along the vas deferens beyond the reach of the knife, and will continue to progress in the vesiculæ seminales and prostate, unless the patient succumb early from disease of the lungs.

SYPHILITIC ORCHITIS, SYPHILITIC SARCOCELE.—Syphilitic disease of the testicle appears under two forms, a simple inflammatory and a gummatous. The latter has frequently been confounded with tubercle, under the name of tuberculo-syphilitic sarcocele. The error arose before the exact nature of the syphilitic gumma was understood. Syphilitic orchitis of both forms may occur either as the result of inherited syphilis in infants or of acquired syphilis in adults. It is usually one of the later manifestations of the disease.

The **Simple Inflammatory Form**, which has been accurately described by Virchow, consists essentially of a chronic inflammation of the connective tissue between the tubuli seminiferi. The disease may uniformly affect the whole gland or be limited to localised patches. If the whole gland be affected, the organ slowly enlarges to perhaps more than double its natural size. The enlargement will be found to affect the body of the gland, the epididymis undergoing but little if any change; in fact, it may be to a great extent concealed by the thickening round it so as to be scarcely recognisable. The cord and vas deferens are unaffected. The body of the gland feels hard, almost cartilaginous, and the surface is smooth or perhaps slightly irregular. There is no pain, except a dragging sensation in the groin due to the increased weight of the testicle. There is little or no tenderness, and in the more advanced stages the peculiar sensation caused by squeezing a healthy testicle is absent. There is no tendency to softening or to the formation of abscess. The disease is almost always accompanied by hydrocele, but at the same time adhesions may exist at various parts between the tunica albuginea and the tunica vaginalis, dividing the fluid into two or more portions, or limiting it to a small part of the surface of the testicle. Most commonly only one testicle is affected, but both may be attacked. In the localised form the induration is limited to one or more portions of the gland, the remainder being soft and healthy.

*Structure.*—On making a section from before backwards, the following appearances are found. If hydrocele exist, the tunica vaginalis will be opaque and thickened, and probably adherent at various points to the surface of the testicle. If no hydrocele be present, the tunica vaginalis may be uniformly adherent. The tunica albuginea will always be found greatly and irregularly thickened, and from it proceed opaque white dense fibroid processes into the substance of the gland. These may in extreme cases be so abundant that no healthy gland-substance can be seen between them ; in less severe cases, patches of healthy tubular substance are found at various parts of the organ. A process of cicatricial contraction taking place in these fibroid processes may lead to a dimpling of the surface of the organ. The microscope shows that the change is due to an inflammatory small round-celled growth, which afterwards undergoes a development into a dense fibroid tissue, situated in the connective tissue between the tubuli seminiferi. The new growth separates, and presses on the tubules, and may lead to their destruction in large areas, as the result of the pressure.

**The gummatous form** is an aggravation of that just described, and presents the same symptoms, with the addition of those caused by the presence of the gummata. These form hard craggy nodules on the surface of the gland, the irregularities so produced being much greater than those arising from simple fibroid induration. The gummata have little tendency to soften, and discharge externally ; yet in rare cases they may do so.

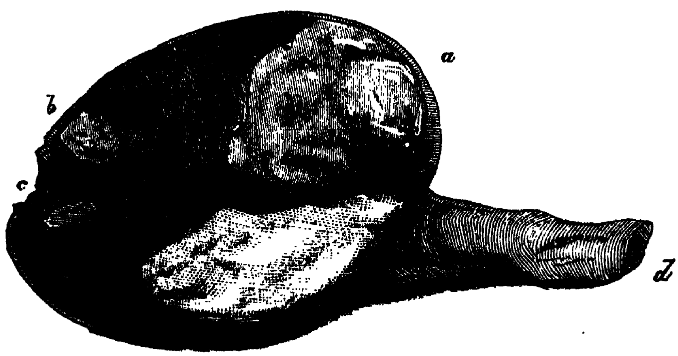


Fig. 851.—Syphilitic Gummata of the Testis. *a*, *b*. Gummata cut across; *c*. Section of Globus minor and Cord.

*Structure.*—On making a section of a gland in this condition, more or less of the fibroid induration, above described, will always be found combined with thickening of the tunics of the testicle. The gummata vary in size, from a split-pea to a hazel-nut. They are of an opaque yellow colour, irregular in shape, and of dense leathery hardness. They may be tolerably sharply circumscribed to the naked eye, but are usually surrounded by a zone of fibrous induration of an opaque white colour. The microscope shows around them the same small-celled growth above described, situated between the tubules. Nearer the centre the tubules are found to be pressed upon and destroyed, and the cells of the new growth commence to undergo degeneration; until, in the yellow part of the gumma, nothing but granular *débris* are to be recognised. The gummata may be distinguished from tubercle by their greater toughness and more opaque yellow colour. Tubercle is rarely limited to the body of the testes; gummata, on the other hand, rarely affect the epididymis.

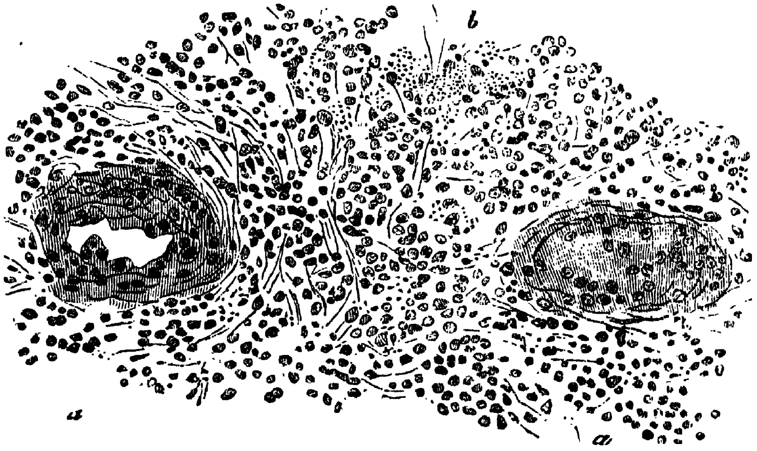


Fig. 852.—Syphilitic Testis. *a*. Tubuli Seminiferi; *b*. A part of the round-celled growth beginning to undergo fatty degeneration (180 diam.).

*Prognosis.*—If the disease be recognised and treated early, complete recovery may be confidently hoped for; although relapses are of frequent occurrence. In the more advanced stages, the prognosis is not so hopeful, as, although under proper treatment the new growth may be absorbed, the gland will remain shrunken, puckered, and indurated. This is but what would be expected; as the tubuli seminiferi, as above stated, become more or less extensively destroyed by the pressure of the new growth in the later stages of the disease.

The *Treatment* is that laid down in Chapter XXXVI. for constitutional syphilis. Locally, the hydrocele may be tapped (but on no account injected), and pressure may be applied, by strapping over some mercurial ointment.

**Diagnosis of the Simple, Tubercular, and Syphilitic Sarcoceles.**—The diagnosis of these affections is in some cases easy, in others very difficult. Whatever the form of disease may be, if it be complicated by hydrocele, this must first be tapped in order that the gland may be accurately examined. The hydrocele in these cases may not be translucent, as the tunica vaginalis is often thickened. It must be remembered that hydrocele is a very rare complication of cancer, or of cystic sarcoma; it is rare with tubercular sarcocele; less rare with simple chronic orchitis, and very common with syphilitic disease. From hæmatocele and tumours, the diagnosis may be made by attention to the rules laid down on p. 974. It having been determined that the swelling is due to one of the three above-mentioned causes, it remains to ascertain which it is. This may be done by attention to the following points. The cord is often thickened and tender in simple chronic orchitis; in tubercular sarcocele, the vas deferens alone is affected, being frequently considerably enlarged; in syphilis, the cord is perfectly healthy. In simple chronic orchitis, the epididymis may be swollen, but the chief enlargement is in the body; in tubercular disease, the epididymis is almost always the starting point of the disease, and is enlarged more than the body; in syphilitic sarcocele, the body is first and almost exclusively affected. In chronic orchitis, the enlargement is usually uniform and smooth, and fluctuation is rarely present; in tubercular sarcocele, the enlarged epididymis is craggy and nodular, and spots of softening may be felt; in syphilitic sarcocele, the body of the gland is greatly indurated, often nodulated, and softening is very rare. The testicle is usually painful and tender in chronic orchitis; in tubercular sarcocele it is sometimes tender, seldom painful; in syphilitic disease, it is almost invariably perfectly painless, and free from tenderness. The constitutional condition of the patient should also be carefully inquired into. Chronic orchitis usually arises as a sequence of injury, or perhaps gonorrhœa, in patients possibly strumous, gouty, or rheumatic; tubercular disease occurs almost always in cachectic subjects, with a tubercular history and a tendency to phthisis. The lungs should therefore be carefully examined. In syphilitic sarcocele, the ordinary symptoms of constitutional syphilis may be present, or a syphilitic history may be obtained. In tubercular sarcocele, the vesiculæ seminales may be felt to be enlarged through the rectum.

Cystic Disease of the Testis, or Cystic Sarcoma of the Testis, or Cystic Sarcocele.—In this disease the testis becomes enlarged, indurated, of a yellowish-white and opaque appearance, and studded with a multitude of cysts, that vary in size from a pin's head to a cherry, containing clear amber-coloured or brownish fluid (Fig. 853). The disease may run a simple or a malignant course. The enlarged testicle may reach a very great size, without showing any signs of general malignancy. In the simpler forms, the disease somewhat resembles the adeno-sarcoma of the mamma. The new growth is found to be composed of a stroma, consisting of various modifications of connective tissue in all stages of growth, in the midst of which are spaces lined with epithelium. The stroma shows great irregularity of structure. In the same specimen may be found fibroid tissue, cartilage, myxoma-tissue, spindle-celled and round-celled sarcoma-tissue. Paget has found the cartilage to be arranged in beaded branching lines, resembling the course and shape of the lymphatic vessels, and has shown that it actually lies within them. The epithelial spaces are irregular in shape and size. It is difficult to say whether they represent the remains of tubuli seminiferi or not. The cysts are formed by dilatation of these spaces, and are lined by a squarish epithelium. Intracystic growths may be found, as in the mamma, projecting

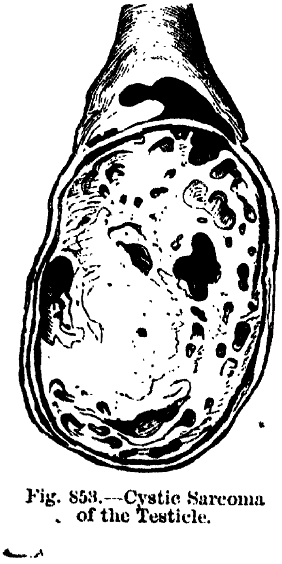


Fig. 853.—Cystic Sarcoma of the Testicle.

into the cysts. The disease may assume a malignant form, either by propagating itself in the internal organs like a sarcoma; or, according to Rindfleisch, actual cancerous transformation may take place, the stroma assuming the form of a cancer-stroma, and the epithelium of the spaces assuming the active growth of the cells of a true carcinoma. According to Curling, cystic disease of the testicle is the result of morbid changes in the ducts of the rete testis.

*Diagnosis.*—This affection has been carefully studied by Sir A. Cooper; who, with great justice, adverts to the difficulty of distinguishing it from other diseases of this organ, more especially from *hydrocele*. The points to be especially attended to in distinguishing the cystic sarcocele, are its want of translucency, the more globular shape of the organ, its weight, and the enlarged and varicose state of the veins of the cord. If there be any doubt, an exploratory puncture will resolve this, and should always be practised.

*Treatment.*—Cystic sarcocele requires removal of the diseased organ.

**Cysts containing Coloured Matters.**—Occasionally, cystic tumours of the testicle are met with, in which the substance of the organ is atrophied or absorbed, and its place occupied by one or more large thin-walled sacculi containing fluids of different colours and consistence, dark or fatty. One of the most remarkable of these anomalous tumours of the testis that I have seen was under the care of my colleague Marshall, at the hospital. The diseased organ, which was about the size of an ostrich's egg, and felt partly solid and partly fluid, was found after removal to be composed of a large cyst filled with an oily fluid, like melted butter, which solidified on cooling. After removal Marshall found that the sac contained some fœtal *débris*, and was doubtless of an embryonic character. The patient, who was about thirty years of age, had been affected with the tumour from early infancy.

**Enchondroma of the Testicle.**—Cartilage, as before stated, is almost always present in the cystic sarcoma of the testis. It may, however, appear alone, deposited in larger or smaller nodules, or infiltrating the gland. It usually commences in the body, but may invade the epididymis; but, according to Cornil and Ranvier, whenever it reaches any considerable size it is no longer purely cartilaginous, but is mixed with sarcoma-tissue and complicated with cysts, so that both clinically and pathologically it merges into the disease just described as cystic sarcoma.

MALIGNANT SARCOCELE, or CANCER OF THE TESTICLE, not unfrequently occurs, and almost invariably assumes the encephaloid character. It is indeed a question whether any other form of cancer ever occurs in the testicle. Walshe agrees with most observers in doubting the existence of the other varieties of malignant disease in this organ.

*Characters.*—Cancer of the testicle most commonly occurs in the first instance in the body of that organ, rarely affecting the epididymis primarily. The ordinary characters of encephaloid are always well marked in this affection; and the tumour eventually becomes softened down, pulpy, and fungous. Intermixed with the encephaloid are commonly found masses of a bright-yellow colour, which have sometimes been regarded as tuberculous, but, I believe, erroneously so; for, in those instances in which I have had an opportunity of examining them, I have found them to consist, as in the simple sarcocele, of plastic matter that was undergoing fatty degeneration. A malignant testicle may rapidly attain a very considerable magnitude, becoming as large as a cocoa-nut in a few weeks or months. When of this size it is, of course, abundantly supplied by blood-vessels; consequently the spermatic artery and accompanying veins will be found a good deal dilated. The lymphatic glands in the neighbourhood speedily become enlarged, those in the iliac fossa especially, as may be ascertained by deep pressure in the flank. The inguinal glands do not in general become affected, until the skin has become implicated by the progress of the disease. It is then also that the cancerous cachexy rapidly develops itself.

The *Symptoms* of encephaloid of the testicle are usually somewhat obscure in the early stages, although they become clearly and distinctly developed as the disease progresses. The patient first begins to complain of some degree of dragging pain and weight in one of the testes, which on examination will be found to be indurated and enlarged, though preserving its normal shape. The enlargement continues until the testicle attains about the size and shape of a duck's egg, being somewhat tense and elastic, but smooth and heavy. As it increases in size, which it usually does with rapidity, it becomes rounded and somewhat doughy or pulpy in feel in parts, where, indeed, it may almost be semi-fluctuating, though in others it continues hard and knobbed. This alteration in feel is partly due to softening of the substance of the tumour, and partly to its making its way through the tunica albuginea. The scrotum is much distended, reddened, and purplish, and becomes covered by a network of tortuous veins; the cord may become somewhat enlarged, hard, and knotty. As the disease advances, the scrotum becomes adherent at some of the softened parts, ulceration takes place, and a fungus projects, which presents all the characteristic signs of fungus hæmatodes; it does not commonly happen, however, that the disease is allowed to go so far as this before removal. The pain is not very severe at first, but after a time assumes a lancinating character, extending up the cord and into the loins. Secondary infection of the system takes place through the medium of the lumbar glands in which the absorbents of the testis terminate. In cancer of the scrotum, just as in the same disease of the penis, the inguinal glands become secondarily affected.

*Treatment.*—The only treatment of any avail in encephaloid of the testicle, is the removal of the diseased organ. This operation is not performed so much with the view of curing the patient of his disease, which will probably return in the iliac glands or in some internal organ, as of affording temporary relief from the suffering and incumbrance of the enlarged testicle. It is therefore an operation of expediency, and should only be done in those cases in which the disease is limited to the testicle, the cord being free and the lumbar glands not involved; so that, if recurrence take place, it may not be a very speedy one.

**An Undescended Testis** may become the seat of structural disease, just as it may be affected by inflammation. The combination of malposition of the organ and structural disease is necessarily rare. But its possible occurrence must be borne in mind by the Surgeon, as it may lead to the necessity of an operation for the removal of the diseased mass from the inguinal canal. Cases of this kind are recorded by Storks and J. M. Arnott. The tumour in the first case was as large as a cocoa-nut; in the second as a man's fist. Both were medullary. The operation consists in exposing the tumour by a free incision—if necessary, carried through the tendon of the external oblique—opening the tunica vaginalis, enucleating the mass, and tying with care the shortened spermatic cord, which would probably be the most difficult part of the operation. The possible co-existence of a congenital hernia must be remembered. But it is remarkable that peritonitis does not appear to be the chief danger of this operation. In neither of the cases above referred to did it occur, the patient dying of erysipelas in Arnott's case; of recurrent cancer, a year after the operation, in that of Storks.*

## OPERATION OF CASTRATION.

This operation may be required for the various non-malignant affections of the testicle that have resisted ordinary constitutional and local treatment, and have become sources of great annoyance and discomfort to the patient; in the early forms of malignant disease, also, it may be advantageously practised. The operation may be performed in the following way. The patient, having had the pubes shaved, should lie upon his back with the legs and thighs hanging over the end of the table. The Surgeon should then take his stand in front of the patient between his legs, and, grasping the tumour at its posterior part with his left hand, make the scrotum in front of it tense. If the mass to be removed be of small size, he makes a longitudinal incision over its anterior surface; if of large size, a double elliptical incision, enclosing a portion of the scrotum. The incision should commence opposite to the external abdominal ring, and be carried rapidly down to the lower part of the scrotum. By a few touches with a broad-bladed scalpel or bistoury, whilst the skin is kept upon the stretch, the tumour is now separated from its scrotal attachments, and merely left connected by the cord, which must then be divided. In some cases, it will be found advantageous to expose and divide the cord in the first instance, before dissecting out the tumour from the scrotum, as in this way a better command over it is obtained.

The **Division of the Cord** constitutes the most important part of the operation, whether this be done first or last; as, unless care be taken, the cord may be retracted through the abdominal ring into the inguinal canal, where it is extremely difficult to follow it, and where the cut stump may bleed very freely, pouring out the blood into its own areolar tissue so as to swell up rapidly, forming a large thrombus, and, if not properly secured, giving rise to extensive and even fatal infiltration into and between the muscles of the part and into the flank. This accident is prevented by tying a piece of tape tightly round the cord above the part to be cut, and giving this into the charge of an assistant (Fig. 854). The arteries of the cord may then be tied separately. A better and safer plan than this, however, and one which I now invariably adopt, is to ligature the cord as a whole. This is done by passing a piece of strong whipcord under the cord, and tying the whole of this structure very tightly before dividing it. In this way hæmorrhage is most effectually restrained; and the ligature separates about the eighth day. It is worthy of remark, that the inclusion of the whole cord in the ligature gives rise to no after-pain of any consequence. Sutures are seldom required, the edges coming into apposition of themselves; the wound must be lightly dressed, and allowed to heal by granulation, bagging in the lower part being prevented during the after-treatment.

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* I would refer those who wish for further information on this subject to Curling's excellent work on the Testis.

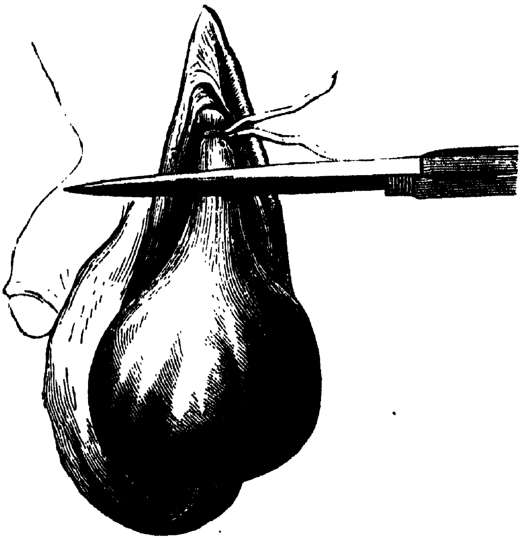

Fig. 854.—Division of the Cord in Castration.

In cancer of the testicle, it is of great consequence to divide the cord as high up as possible, for obvious reasons. It will not, however, be safe to do this opposite the abdominal ring in the way that has just been described, as there would not be sufficient space for the assistant to hold the cord above the part to be divided. In cases of this kind, I have found it a good practice to expose the cord by dissection up to the abdominal ring; then to draw it well down, and to include the whole in a strong whipcord ligature, tied round it as tightly as possible. The section is then made a quarter of an inch below this, and the operation is completed as usual; the cut stump of the cord may retract into the inguinal canal, but cannot bleed if properly tied, and will always be under command by drawing upon the whipcord. This plan of tying the cord *en masse* was at one time generally adopted in all cases of castration, but is not now commonly employed. The objection to it is, that by compressing the spermatic nerves with the ligature the after-pain is increased; but this certainly does not always happen, for, in the instances in which I have done it, but little pain was complained of; and the practice in malignant disease of the testicle has the advantage of enabling the Surgeon to divide the cord at a higher point than he otherwise could; which advantage is still further increased by the parts within and below the ligature sloughing away, and thus eventually carrying the section to a level with the point tied.

There is one danger that may occur in castration in young children. It is that in young subjects the processus vaginalis testis may not be obliterated, and that thus the peritoneum may be opened up into the wound on dividing the cord. In one case I have known this condition to lead to fatal peritonitis.

## GENERAL DIAGNOSIS OF SCROTAL TUMOURS.

The diagnosis of scrotal tumours is not only of considerable importance, but is often attended with very great difficulty: the more so, as they are frequently associated with one another, so that much tact and care are required to discriminate their true nature. Thus it is not uncommon to find a hydrocele and a hernia; a hydrocele and a varicocele; or these affections co-existing with a solid tumour of the testicle. In other cases, again, as in the annexed figure (855), an encephaloid tumour may co-exist with a hydrocele of the tunica vaginalis, and with an encysted hydrocele of the cord.

Tumours of the scrotum may, in a diagnostic point of view, be divided into two distinct classes :—1, the Reducible ; and 2, the Irreducible.

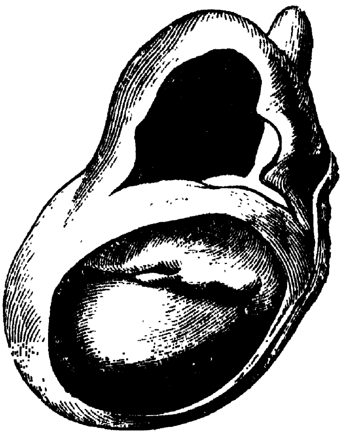

Fig. 855. -- Encephaloid Testicle with Hydroceles of the Tunica Vaginalis and of the Cord.

1. Reducible Tumours.—These are Hernia, Congenital Hydrocele, Diffuse Hydrocele of the cord, and Varicocele ; in all of which the swelling can be made to disappear more or less completely by pressure and by the patient lying down ; reappearing on the removal of the pressure, or on his assuming the erect posture. The mode in which the tumour disappears, tends greatly to establish its diagnosis ; though the general character of the swelling, and the history of the case, afford important collateral evidence on this point.

*a.* In **Hernia** there are the ordinary signs of this affection, such as impulse on coughing, &c. On reducing the tumour, it will be found that its return into the abdomen is accompanied by a gurgling noise, and by the sudden slip upwards of evidently a solid body. In the other reducible tumours, the diminution and eventual disappearance under pressure are more gradual, and there is no reduction of the mass as a whole.

*b.* The gradual squeezing out of the contents of a **Congenital Hydrocele**, together with its translucency, and the early age at which it occurs, will establish its true character.

*c.* In the **Diffuse Hydrocele of the Cord**, there is an uniform semi-fluctuating swelling in and near the ring ; in which, however, there is no gurgling, &c., no complete and sudden disappearance as in hernia. It is also less defined, and has a less distinct impulse on coughing.

*d.* **Varicocele** may always be distinguished by its pyramidal shape, and its knotted, soft, and irregular feel. After being reduced when the patient lies down, it will, when he stands up, fill again, even though the Surgeon compress the external ring with his fingers. This sign, which distinguishes it from a hernia, occurs also in congenital hydrocele ; from which, however, the varicocele may be distinguished by the absence of translucency, the want of fluctuation, and the general feel of the tumour.

2. Irreducible Scrotal Tumours are of various kinds ; such as Omental Hernia, Hydrocele, Hæmatocele, the various forms of Sarcocele, and Cancer of the Testicle. These tumours, though presenting certain characters in common, yet differ somewhat in the predominance of particular signs. Thus, the shape of the tumour is usually pyriform in hydrocele, globular in hæmatocele, and oval in sarcocele ; though this is subject to much variation. The weight is least in hydrocele and greatest in sarcocele, proportionately to the size of the tumour. The characters of the surface present considerable differences, being smooth and tense in hydrocele and hæmatocele ; often irregular, hard, or knotted in the other varieties. The rapidity of the formation of the tumour is greatest in hæmatocele.

*a.* **Irreducible Scrotal Hernia** may be recognised by its irregular feel, by its impulse on coughing, by its occupation of the canal, and by the testicle being distinctly perceptible below it.

*b.* **Hydrocele of the Tunica Vaginalis** is always recognisable by its translucency; and the amount of opacity conjoined with this will enable the Surgeon to distinguish the degree of enlargement of the testis, and how far there is a sarcocele conjoined with it.

*c.* In **Hæmatocele** the tumour is of sudden or rapid formation, somewhat globular, opaque, but not very heavy or hard, and smooth upon the surface.

*d.* In **Sarcocele** generally the tumour is heavy for its size, frequently globular or irregular in shape, sometimes knobbed, and usually attended by a good deal of dragging pain in the groin, and frequently by some enlargement of the cord.

In these three forms of scrotal tumour, viz., hydrocele, hæmatocele, and sarcocele, the diagnosis can always be made at once from hernia, by the Surgeon feeling the cord free above the tumour.

The point of most importance in the diagnosis of sarcocele is to distinguish the *malignant* from the *non-malignant* varieties. In the malignant the rapidity of the growth, the softness and the elasticity of the tumour, the implication of one testis only, and the early enlargement of the cord, with its indurated and knobbed condition, are important signs; especially if the disease occur in young men. In a more advanced condition, the softening of the swelling at parts with a tuberous condition of the rest, and the occurrence of fungus with speedy constitutional cachexy, will point to the malignant nature of the tumour. In cases of much doubt and difficulty an exploratory puncture may be made, when the contents of the groove in the needle or of the fine cannula will probably determine the character of the growth. In more than one instance, in which there was much obscurity, I have seen the true nature of the disease cleared up in this way.

## SPERMATORRHŒA AND IMPOTENCE.

Various forms of debility, of loss of power, or of irregularity of action in the generative organs of the male, are confounded together under the terms **Spermatorrhœa** and **Impotence**. These conditions require a more careful consideration on the part of the educated Surgeon than they have hitherto received, as their existence is a source of the deepest mental depression and distress to the sufferer. They are certainly one cause of conjugal unhappiness, leading perhaps to infidelity on the part of the wife, and occasionally even to suicide of the husband. These affections, which are of extreme frequency amongst all classes of the community, having scarcely as yet received that attention on the part of the profession generally that their importance deserves, the unfortunate sufferers from them are too often driven into the hands of those pestilent quacks who flourish in the metropolis, and infest almost every town in the country, by whom they are not unfrequently ruined in health as well as in purse.

The **Sexual Melancholia** that accompanies these conditions, is one of their more striking characteristics. The patient is languid in manner, depressed in spirits, his countenance is pale and haggard, eye dull, expression listless, and devoid of all energy. He takes no interest in the ordinary affairs of life, his whole thoughts are concentrated on his own condition, and he feels himself degraded as being unfit for that duty which is alike the first and the lowest of man. This state of mind is commonly the result of some local irritation or disease, re-acting on a morbidly sensitive nervous system; and on examination, the Surgeon will commonly find some local condition that has been the starting point of the mental malady. Balanitis, phimosis, or varicocele in the male; uterine or ovarian irritation, congestion, or disease in the female, are the common occasioning causes. But the most frequent direct exciting cause is undoubtedly that pernicious and disgusting habit alike destructive of bodily vigour and of mental power, which, heedlessly contracted in youth, lays the foundation for an effete and impotent manhood, and for premature senility in the one sex, and entails hysteria, in its most aggravated and intractable forms on the other.

We may recognise at least three distinct varieties of generative debility in the male, of whom I alone speak, which may in some cases amount to actual impotence: 1. True Spermatorrhœa, or Seminal Flux; 2, Spasmodic Spermatorrhœa, or Spermaspasmos; and, 3, that arising from Want of Seminal Secretion, or Asperma.

1. TRUE SPERMATORRHŒA, or SEMINAL FLUX, is chiefly met with in young men usually from the ages of eighteen to thirty. It is commonly the consequence of that hideous sin, engendered by vice, and practised in solitude, which alike emasculates the body, enfeebles the mind, and degrades the moral nature of its perpetrator, or of debility of the generative organs induced by gonorrhœa, or of the continued struggle to repress the natural sexual desires by a life of forced or unavoidable continence. In this form of the disease there is a mixture of irritability and of debility. The generative organs are excited by slight emotional causes, or by trivial and ordinary physical stimuli —a thought, a look, a word, the movement of a carriage, the effort of straining at stool, will excite the secretion of the testes, which the debilitated state of the parts allows to escape with a feeble ejaculatory effort, or in a kind of leakage of a few drops from the urethra. In the slighter cases, and in the earlier stages of the malady, these emissions take place but occasionally—three or four times a week, chiefly in the morning, in the mid state between waking and sleeping, and are preceded by an erection. In the more advanced stages, the emissions occur once or oftener in the twenty-four hours without an erection; the semen at last, when discharged, flowing back into the neck of the bladder, escaping with each discharge of the urine, or being squeezed out after defecation. The patient's physical and mental state becomes seriously implicated in these more advanced cases of true spermatorrhœa. His countenance is pallid, anæmic, and sallow; his features are drawn, their expression is listless; his eyes lifeless; his spirits depressed, often to the lowest depths of despondency and despair. Connection is impracticable, as the discharge of semen takes place either before erection occurs, or without its occurrence.

*Diagnosis.*—This form of spermatorrhœa is apt to be confounded with *prostatorrhœa* (p. 870, vol. II.); but the diagnosis may always be effected by a microscopical examination of the discharge.

An occasional involuntary emission is not true spermatorrhœa. It is common to young men of an ardent and excitable temperament, and is often the occasion of much groundless alarm. It occurs at that period of life when the generative power and sexual feeling are at their highest point of development. It is simply the result of a hypersecretion of the testes and overflow of the semen. For its repression, moral advice and medicinal agents are equally unnecessary and unavailing. For it, early and congenial marriage is the only remedy. Unless this be adopted, Nature will assert herself—she is indifferent to social considerations—she will enforce her rights in spite of all restraint. "Naturam expellas furcâ ; tamen usque recurret."

*Treatment.*—The curative treatment should consist in giving tone to, and in lessening the irritability of, the genito-urinary organs. In these cases it becomes necessary to maintain and improve the tone of the system by remedies calculated to remove the anæmia and to stimulate the nervous energies. With this view, the preparation of iron, phosphorus, nux vomica, and cantharides will be found the most effective. The syrup of the phosphate of iron and strychnine, or the tincture of the perchloride of iron, in combination with those of nux vomica and cantharides, will be found of the greatest service. But under any form of treatment the cure will be slow, and long-continued perseverance in the use of remedies, local and constitutional, is imperatively necessary. In addition to these means the cold hip-bath should be assiduously employed. This the patient should use every night and morning ; remaining in it, at first, for about three minutes, but gradually increasing the time of immersion to ten or fifteen. The patient must sleep on a hard mattress, be lightly covered, and eat no supper. Some satisfactory mental occupation should also be provided, or travelling if possible. In some cases the cold shower-bath appears to give more tone, and then should be preferred. These means, useful as adjuncts, will not, however, cure the patient. For this purpose, the local irritability must be removed by the application of the nitrate of silver to the prostatic and bulbous portions of the urethra. It will usually be found that there is a good deal of tenderness in these situations, felt on pressing upon the perinæum, or on passing an instrument into the urethra, when, as the point enters the bulb, the patient will suffer much pain. The continuance of this irritation certainly keeps up the seminal emissions, and thus maintains the debility of the genital organs, and the nervous irritability, that are so characteristic of these cases. It may most effectually be remedied by the application of the nitrate of silver, as originally recommended by Lallemand ; and, if this be done in a proper manner, a cure will usually be accomplished. For many years past I have employed, with much advantage in such cases, the instrument here figured (Fig. 856). It consists of a silver catheter,

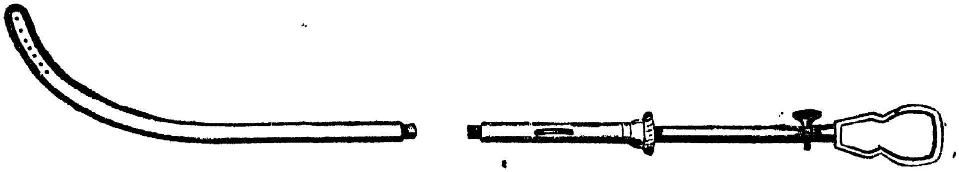

Fig. 856.—Syringe-catheter for applying Caustic to the Urethra.

having about a dozen minute apertures near the end. In the interior is contained a slender piece of sponge, about two inches long, fixed to the expanded end of a firm stylet that moves within the catheter. The instrument is charged by filling the sponge with some solution of nitrate of silver by withdrawing the stylet. It may then be well oiled ; and, being passed down to the spot to be cauterised, the solution is forced out of the aperture by pushing down the rod, which compresses the sponge. I have found this syringe-catheter far safer and more manageable than Lallemand's or any other *porte-caustiques* that act by protruding a spoon or sponge, which is apt to be grasped by the spasmodic action of the muscles of the part, often being returned with difficulty into the shaft, and not without risk of lacerating the mucous membrane. I generally use a solution of the strength of ʒj of the nitrate to an ounce of water ; though sometimes only a half or a third of this strength can be borne. The application usually occasions a good deal of irritation for a time, sometimes even a muco-purulent discharge, and can only be repeated at intervals of from ten days to a fortnight. Any undue amount of irritation, particularly after application, must be subdued by ordinary antiphlogistic treatment. After the nitrate of silver has been used two or three times, the treatment may be advantageously continued by passing twice a week a similar instrument charged with tannate of glycerine. This acts as an admirable astringent, and suits many people better than the nitrate.

2. SPASMODIC SPERMATORRHŒA, or SPERMASPASMOS, more frequently occurs between the ages of twenty-five and forty. It is frequently predisposed to by residence in a warm climate, or by the existence of some disease about the generative organs ; such as stricture, varicocele, neuralgia testis, &c. In these cases there is not, properly speaking, a seminal flux ; but complete connection cannot be effected, as erection and ejaculation are either simultaneous acts, or the erection partially subsides before the emission takes place. This form of generative debility is often as much dependent on mental or moral as on purely physical causes.

*Treatment.*—This is a condition of irritability rather than of debility. It often occurs in strong and otherwise healthy men, accustomed to field-sports and out-of-door exercises. There is no evidence of anæmia or of debility of any kind. Hence tonics are not necessary ; nor, indeed, would they be in any way useful.

The remedy most to be relied upon is the bromide of potassium in doses of 20 to 30 grains, with local cold bathing, and, perhaps, when there is urethral irritation, blisters to the perinæum and along the penis, with belladonna to the interior of the urethra. In addition to these means, it is of the first importance to enjoin moderation in food and drink, and above all, avoidance of alcoholic stimuli ; for, in many of these cases, it will be found that abdominal plethora co-exists, and exercises an injurious influence.

3. IMPOTENCE arising from absence of all sexual desire or power, or from premature decay of that power, is not unfrequently met with, and often in individuals who are otherwise strong and healthy ; sometimes, indeed, in those characterised by great muscular power, and much given to athletic exercises. This want of sexual desire may be looked upon in many instances as a natural deficiency in the organisation of the individual, for which medical

or surgical treatment can do little. In other cases it arises from exhaustion of the nervous system by habitual physical or mental exertion, by excessive sexual indulgence, over-training, or study, carried to too great and injurious a degree. Complete absence of seminal secretion—*Asperma*—except in cases of atrophy or absence of the testes, must be especially rare. In a patient of mine who died at 54 years of age, and who, according to his own and his wife's account, had been completely impotent for the twenty-four preceding years, spermatozoa in considerable quantities were after death found in the testes, which were carefully examined with the view of ascertaining whether they ever secreted semen.

STERILITY in the male is a condition that has attracted some amount of attention of late years. It is, of course, not unfrequently connected with, and probably dependent on, the same conditions that give rise to the various forms of sexual debility that have just been described. But it may occur independently of any of these states, in individuals, indeed, who are possessed of a very considerable amount of sexual desire and vigour. It would appear to be due to some morbid condition of the seminal fluid, in consequence of which the spermatozoa are either absent, or are possessed of insufficient vitality to effect impregnation. The causes of this condition are very obscure; but over-indulgence in sexual intercourse appears to be amongst the most frequent. It would seem as if each individual were endowed with a certain given amount of procreative power, which, if early exhausted, or habitually wasted in indiscriminate intercourse, cannot be restored. Hence, polygamists in the East, or their Western congeners, do not propagate, as a rule, more than the average number of children. Amongst organic causes of this state, chronic epididymitis appears to be the most frequent (p. 943). The only *Treatment* that can be adopted with any prospect of success, is in the one case prolonged avoidance of sexual excitement, and in the other the removal of local disease existing in the urethra or testis, such as stricture, or thickening or condensation of structure, by the long-continued use of absorbent remedies on general principles. Tonics are valueless in such cases.

In conclusion I need scarcely say that, in the treatment of that general melancholia or hypochondriasis that accompanies these various affections, much good may be effected by means that directly influence the spirits and the mental condition of the patient. He should be encouraged to travel, to occupy himself with healthy out-door pursuits and amusements, to take regular exercise, to avoid all enervating habits; and, above all, his mind should be cheered by the hope of eventual cure. Should there be any local disease, such as balanitis, phimosis, or varicocele, that should be subjected to treatment or operation.

# CHAPTER LXXV.

## DISEASES OF THE FEMALE GENITAL ORGANS.

Some of the more important surgical affections of these organs, such as vagino-vesical and recto-vaginal fistulæ, lacerated perinæum, &c., have already been discussed. The remaining affections, implicating the Vagina, the Uterus, and the Ovaries, are of considerable practical interest ; but, as their full consideration would lead me far beyond the limits that can be assigned to them in this work, and, indeed, belongs to another department of Medicine, I must content myself with a brief indication of the principal surgical points deserving attention.

### INTRODUCTION OF INSTRUMENTS.

Speculum Vaginæ.—Vaginal specula of various shapes and materials are commonly used by Surgeons. When the os and cervix of the uterus require exploration, the most convenient instrument is certainly the cylindrical reflecting glass speculum (Fig. 857) ; which, being coated with a layer of tinfoil, covered by India-rubber, always presents internally a mirror-like surface, by which a strong body of light is thrown into the bottom of the tube.

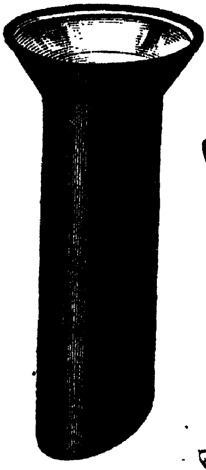
Fig. 857.—Cylindrical Speculum.

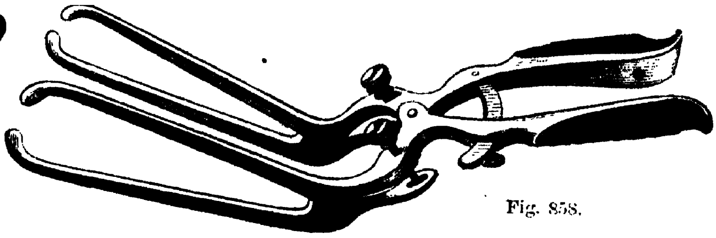
Fig. 858.

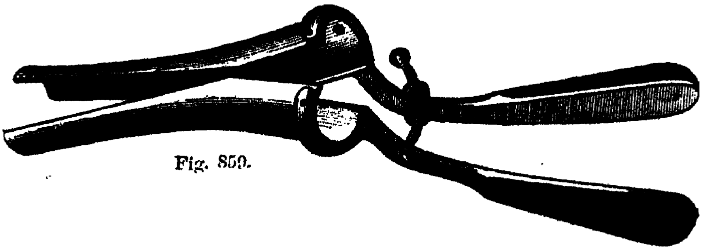
Fig. 859.

Fig. 858.—Branched Speculum. Fig. 859.—Bivalve Speculum.

It has the additional advantage of being very cleanly, and not stained by any caustics that may be used in it. These specula should be of different sizes, and may be sometimes advantageously bevelled off at the inner end. When the wall of the vagina requires examination, as in some operations for fistula, a bivalve speculum (Fig. 859), one with expanding blades (Fig. 858), a cylindrical one, provided with a sliding side, or the "duck-billed" speculum (Fig. 819) may advantageously be used.

**Introduction of the Speculum** may readily be effected, without any exposure of the person, under the dress or bed-clothes. There are two positions in which the patient may conveniently be placed for this purpose. In the first, she lies upon her back, with the nates well raised or brought to the edge of the bed or couch, her legs separated, and her feet resting on two chairs; the Surgeon, standing or sitting in front of the patient, introduces the fore and middle fingers of his left hand into the vagina, dilates its walls, passes the speculum, well greased, gently and steadily between and under them. This position is the most convenient when caustics require to be applied, but is often objectionable to the patient, as it appears to entail much exposure, though in reality it need not do so. Another mode of introducing the speculum, which should always be adopted when practicable, consists in placing the patient on her left side across the bed, with the knees drawn up, and the nates near the edge; the instrument is then introduced in the same way as before, the Surgeon sitting by the patient's side. In whichever way the speculum is used, no force should ever be employed; the patient should be placed opposite a good light, and care should be taken that the instrument be introduced fairly to the uterus, the position of which may have been previously ascertained by tactile examination.

FEMALE CATHETER.—The use of the female catheter is often required in various diseases and operative procedures about the genito-urinary organs of women. It should be introduced without exposure, by the aid of the touch alone. This may readily be done, as the patient lies in bed, under the clothes. The Surgeon, standing on her left side, passes his left index-finger downwards between the nymphæ until he feels the projection of the meatus urinarius, immediately above the entrance into the vagina; keeping his finger just below this, he uses it as a guide to direct the point of the catheter into the canal. Or the reverse way may be adopted: the Surgeon, passing his finger just into the orifice of the vagina, feels the urethra like a cord under the arch of the pubes. He carries it along this until the urethral orifice is reached, when the catheter is slipped in. This method has the advantage that the clitoris is not touched, a matter of importance in hysterical females.

## DISEASES OF THE EXTERNAL ORGANS AND VAGINA.

The vulva and the nymphæ are the seats of numerous morbid conditions, principally consisting of hypertrophy or of verrucous growths from them, or the formation of cysts in their substance.

HYPERTROPHY OF THE LABIA to a limited extent is not unfrequently met with, one labium hanging down considerably below the other. In these cases, it will often be found that the enlargement is due to a kind of solid œdema, originally dependent, perhaps, upon a fissure or ulcer of the part. In other cases, large fibro-cellular tumours form as outgrowths from the natural structures in this region ; these may require removal by simple excision.

LARGE CONDYLOMATA or VERRUCÆ are often met with here as the result of gonorrhœal or syphilitic disease, forming at last irregular pendulous masses, which require extirpation, either by knife or scissors. I have had occasion also to remove a large *Nævus* by ligature from this situation ; and, in fact, any growth that occurs in the skin or cellular tissue may be met with here.

CYSTIC TUMOURS are not unfrequently met with in the labia, and may sometimes resemble rather closely the ordinary forms of inguinal hernia ; with which, however, their incompressibility, irreducibility, and the absence of impulse on coughing, will prevent their being confounded. These cysts, which require removal by a little simple dissection, usually contain a dark, turbid, or sanguineous fluid, and sometimes atheromatous matter. Tolerably free hæmorrhage may follow their removal, the excitable tissues of the labia being cut into. This may, however, always be arrested by pressure and a T-bandage. Occasionally they project from the inside of the vagina, and then require removal by dissection or ligature, as can be best practised.

IMPERFORATE VAGINA is occasionally met with in young children, and occasions a good deal of anxiety to the parents. This condition, however, may always be very readily and speedily removed by tearing open the canal, as it were, by dragging open its walls in opposite directions, and breaking through the adhesions, which are little more than epithelial, with the thumb-nail, a blunt probe, or the handle of a scalpel, and then introducing a small pledget of greased lint.

IMPERFORATE HYMEN is occasionally met with, causing great inconvenience, and even danger, by the retention of the menstrual secretion, which may accumulate to an immense extent, and become converted into a kind of chocolate-coloured grumous fluid. This malformation does not usually attract attention until the age of seventeen or eighteen. When the menstrual flux has, however, not appeared, notwithstanding periodical constitutional disturbance, an examination is instituted, and the cause of the obstruction is revealed. In these cases the hymen, which forms a dense elastic membrane, is pushed down between the vulvæ, and the accumulated secretion may sometimes be felt as an elastic fluctuating tumour above the pubes or in the iliac fossa.

The *Treatment* consists in puncturing the hymen with a trochar, enlarging the opening with a probe-pointed bistoury, and thus discharging the retained fluid, which may be in very large quantity. This operation is not always unattended by danger. Suppuration of the exposed cavity and peritonitis may come on, ending in the patient's death. In opening the membrane, it need scarcely be said that wound of the urethra should be carefully guarded against ; and, with care, that canal may always be avoided. I have, however, seen one case in which it had been slit up by the Surgeon who punctured the membrane.

Occasionally the Surgeon's advice may be sought by married women, for a rigid and only *partially perforate hymen ;* when incision with a probe-pointed bistoury and dilatation with a sponge-tent may be required. Impregnation, however, is possible, even though the hymen be not ruptured ; and it may be necessary during parturition actually to complete the division of that membrane, if thickened and unruptured, though in most cases it gives way under the pressure of the fœtal head.

It may happen that surgical aid is needed to supplement conjugal efforts in the consummation of the marriage rite. In these so-called "delicate" cases, anæsthesia having been induced, the Surgeon introduces a small bivalve speculum shut (Fig. 859), or an ordinary "glove-stretcher," and, expanding the blades, ruptures the hymen, and dilates the vagina to the necessary extent as he withdraws the instrument.

ABSENCE OF THE UTERUS AND OVARIES, with imperforate vagina, is occasionally met with in women, otherwise perfectly well formed : the external organs of generation, labia, and nymphæ being present, and the breasts developed. In such cases, it is remarkable that sexual desire usually exists. The true condition may, however, be detected by an examination *per rectum*, and especially by the introduction of a catheter into the bladder whilst the finger is in the rectum, when the two cavities will be found to be in close apposition without the intervention of uterus or ovaries, the point of the instrument being felt thinly covered through the gut. In two of the cases of this kind in which I have been consulted, there had been monthly epistaxis. No surgical interference can be of any avail in such cases ; and an attempt to restore the vagina would necessarily lead to fatal results by opening the peritoneal cavity. Occasionally, if the woman has been married, the fruitless attempt at coition on the part of the husband has caused dilatation and expansion of the urethral orifice to such an extent, that the index finger may be introduced into the cavity of the bladder. I have known this expanded urethra mistaken for the vaginal aperture, coitus effected into it, and the existence of the malformation for a long time completely overlooked. *Simultaneous* vesical and rectal exploration will always clear up the true nature of the case.

HYPERTROPHY OF THE CLITORIS is occasionally met with ; this organ becoming enlarged, elongated, and pendulous, and in some cases attaining an enormous size. Hargrave mentions an instance where it was found after removal to constitute a tumour weighing five pounds and a half. When the clitoris is enlarged, it may give rise to a good deal of irritation, and require excision, an operation that is often followed by rather troublesome hæmorrhage, requiring the use of the actual cautery for its arrest.

**Removal of the Clitoris**, even though not enlarged, was some years ago recommended and extensively practised as a means of cure in some forms of epilepsy and of erotomania. This is an operation as unscientific as it would be to remove the glans penis for the cure of similar affections in the male, and one that the experience of the profession has proved to be as useless in its results as it is unscientific in its principle.

TUMOURS of various kinds are met with in the interior of the vagina, springing from its walls. These may be of a **Cystic** character ; but occasionally true **Mucous Polypi** are found dependent and projecting from the side of this canal. These may most readily be removed by transfixing their base by a double whipcord ligature, and then strangling it. In performing this operation, however, when the tumour grows from the posterior wall, care must be taken to ascertain by proper digital examination, that a portion of the rectum has not been dragged down into its base.

VAGINAL HÆMORRHOIDS are occasionally though rarely met with. They chiefly occur towards the anterior part of the vagina, or about the lower wall of the urethra, as rounded, smooth, purple masses of enlarged and congested veins. In one case I have seen a mass of this kind in an old lady give rise to permanent incontinence of urine or dysuria, by keeping the urethral aperture patent. Destruction by the galvanic cautery is the best method of treatment.

PROLAPSUS of the anterior or the posterior wall of the vagina may occur, giving rise, in the first instance, to protrusion of the bladder, or **Cystocele**; in the other, to a **Rectocele.** In either case, but especially in the first, it occasions very serious and troublesome consequences, amongst which chronic irritation of the mucous membrane of the bladder, with perhaps phosphatic deposits in the urine, are the most marked. These protrusions may be supported by the use of properly constructed belts or pessaries.

In some cases the Surgeon may feel disposed to undertake plastic operations, in order to narrow the vaginal orifice by freely paring the opposite portions of its walls, bringing together the freshened surfaces by means of the quilled suture, and thus procuring narrowing of the canal and permanent support to the protruded part. The success of such operative proceedings will greatly depend on attention to details. The mucous membrane at the orifice of the vagina should be dissected off from about half an inch below the meatus on one side, to a corresponding part on the other, in a strip about an inch and a half wide; the dissection being carried well up posteriorly in the fourchette. Two or three deep, and as many superficial, sutures should be passed; the deep being left in for about five, the superficial for seven days. Great attention should be paid to cleanliness, the patient lying on her side with a catheter in the bladder communicating with an India-rubber tube to carry off the urine; and the bowels should be confined by opium.

VARIOUS DISCHARGES connected with the female organs of generation fall under the observation of the Surgeon; these may occur from the external organs, from the mucous membrane covering the cervix uteri, or from the interior of the cavity of that organ. These discharges, when proceeding from the mucous membrane covering the external organ, or lining the vagina, are frequently, though not necessarily, of a gonorrhœal character; and then require to be treated in the way that has been mentioned at page 855, Vol. II. When they are of a simple nature, proceeding from mere excessive secretion of these parts, astringent injections, and attention to the general health, will usually succeed in effecting a cure.

When these discharges proceed from the cervix or the interior of the os uteri, they will commonly be found to be dependent upon a chronically inflamed or congested condition of the organ, or upon a papillated, granular, fissured, or ulcerated condition of the mucous membrane, often connected with more or less local thickening and induration of subjacent structures. These various conditions, often of a very persistent, insidious, and destructive character, have of late years been fully recognised by the labours of some of the French Surgeons, more particularly of Lisfranc, Emery, and Jobert; and in this country their pathology has been greatly elucidated by Simpson and

Bennet. To Bennet especially is due the great credit of having pointed out the true pathology of various uterine diseases that were previously but imperfectly recognised, and of having shown that many of the so-called functional diseases of the uterus are in reality dependent upon congestion, inflammation, and other structural lesions of this organ.

*Symptoms.*—These uterine discharges, occuring usually as the result of chronic inflammation and its consequences, just as we find on other mucous surfaces, as those of the urethra, throat, or eyelids, are attended by various symptoms indicative of local distress : such as pain in the back and thighs, and more especially in the left groin, with dysmenorrhœa, and usually a good deal of sympathetic constitutional irritation, terminating in impaired digestion, malnutrition, and anæmia. It is in this condition of the system that many of the so-called hysterical affections are apt to arise ; and the Surgeon often finds that the most inveterate cases of neuralgia of the joints, the spine, the hip, or the breasts, and of amaurotic and other obscure affections connected with nervous irritation, are primarily dependent on chronic uterine disease : and it is only by attacking and removing this, that he can remedy the secondary mischief. On examining the condition of the cervix and os uteri in these cases by means of the speculum, various morbid changes are observed in them ; the cervix is perhaps thickened, indurated, or knobbed on one side ; the os is frequently patulous ; and the mucous membrane covering these parts will be observed to be erythematous, congested, and perhaps excoriated, not unfrequently in a granular condition, closely resembling what may be observed in some forms of granular conjunctivitis. In other cases, again, true ulceration may exist both upon the cervix and within the os. These ulcers, abrasions, excoriations, or by whatever term they may be designated, are unquestionably a fruitful source of mischief in this situation, giving rise to considerable thickening of subjacent structures, and usually to abundant muco-purulent discharge and much sympathetic irritation. In character they closely resemble corresponding forms of disease met with on the mucous surface in other situations, not attended by loss of substance, but by the development of small pointed granulations or papillæ, from which the discharge is poured forth.

The *Treatment* of these various affections of the uterus has been materially simplified since their pathology has been better understood ; and practitioners are now generally agreed as to the necessity of the employment of energetic local measures for the removal of these morbid states. To the Surgeon who is in the habit of managing local disease on other mucous surfaces, and of removing the structural lesions that result from chronic inflammation in other organs, the treatment of these cases can present little difficulty, as it is conducted on precisely the same principles that guide him in the management of similar affections elsewhere.

The employment of caustics is of essential service in these various forms of chronic uterine disease. In cases of simple ulceration or excoriation, the nitrate of silver in stick, applied every third or fourth day, will frequently be found to effect a speedy cure. For this purpose, the hinged caustic-holder will be found a useful instrument. If there be much chronic induration, conjoined with the affection of the mucous membrane, the potassa cum calce, fused into narrow sticks, may very advantageously be used. In doing this, however, care must of course be taken that the cauterising action do not extend too far. Hence the Surgeon, after lightly touching the diseased part, whether this be on the cervix or inside the os, should immediately inject some weak vinegar and water, so as to neutralise the alkali. After these applications, which should only be repeated at lengthened intervals, the patient must be kept quiet for some time; and any inflammatory symptoms that may be excited must be combated in the usual way; it very rarely happens, however, that anything untoward will result.

After the removal of the local disease in the way pointed out, any remaining congestion may be got rid of by the application of leeches to the cervix. During the time when these local measures are being adopted, recourse must be had to proper constitutional treatment, with the view of improving the general health on ordinary medical principles. The details of this treatment need not be given here; but for a full exposition of them, as well as for a vast deal of important information on the surgical management of uterine affections, I would refer the reader to the last edition of Bennet's work on the Uterus.

UTERINE DISPLACEMENT.—The various displacements to which the uterus is liable, whether downwards, constituting **Prolapsus**, or in the direction of the axis, being twisted, and either **Retroverted** or **Anteverted**, are causes of much local suffering and constitutional disturbance, and commonly require surgical treatment. These various conditions will frequently be found dependent on inflammatory congestion of the fundus, in consequence of which the organ becomes, as it were, top-heavy, and is tilted to one side, or descends bodily in the pelvis.

The *Treatment* in such circumstances must have reference to the removal of the local turgescence by the application of leeches, the employment of astringents, hip-baths, and the recumbent position; occasionally assisted perhaps, in twist of the organ, by attempts at replacing it by introducing the uterine sound into its cavity, or when it is prolapsed, by supporting it with appropriate pessaries and the abdominal bandage.

VAGINAL DISCHARGES of a purulent character not unfrequently occur in young female children, as the result of constitutional debility or strumous derangement. Occasionally such discharges lead to the suspicion of the child having been improperly tampered with; and, although they may of course be occasioned by some violence inflicted on the genitals, or even from gonorrhœal infection, it must be borne in mind that, in the great majority of instances, they certainly arise from constitutional conditions solely, and are in no way referrible to external causes. The *Treatment* consists in attention to cleanliness, the use of warm lead lotions, and the improvement of the general health.

TUMOURS OF THE UTERUS are of various kinds. The most common are those of a **Fibrous** character. These are often of considerable size, and have been found weighing many pounds; they may occupy almost any portion of the uterus, either projecting into the peritoneal cavity, occupying the interior of the organ, or dependent into the vagina. These tumours seldom occur before the age of thirty or forty, and are not very amenable to *Treatment*. In some cases, however, considerable benefit results from attention to position, the occasional application of leeches to the cervix, so as to lessen the congestion of the organ, and the introduction into the vagina every night of a ball composed of equal parts of strong mercurial ointment, wax, and lard, or one containing iodine or the iodide of lead, with the view of acting as an absorbent on the morbid tissue.

**Polypi** are not unfrequently met with, growing from the inner surface of the uterus, usually from its posterior aspect or fundus. These growths are generally oval or pyriform, smooth, hard, insensible, and fibrous in structure. They are often the cause of repeated and dangerous hæmorrhage; and it is a remarkable fact that in many cases the most violent and persistent bleeding proceeds from the smallest tumours. In other cases, the polypi of the uterus are of a soft, fibro-cellular, vesicular, or mucous character, attended, like the harder ones, by free hæmorrhage.

*Treatment.*—Polypi may be removed in various ways. 1. By *torsion.* When the tumour is small and situated within the uterine cavity, a long pair of broad-ended forceps may be introduced through the patulous and turgid os, and the polyp readily twisted off from its attachment. 2. By *excision.* When the tumour is large and pyriform, has an elongated pedicle, and projects through the os, the patient may be placed in the position for lithotomy, and the labia opened and held aside by retractors: the growth may then be drawn down by a large pair of vulsellum-forceps, so as to bring its neck well within reach, and this may then be cut across with a long pair of scissors or a probe-pointed bistoury. After removal, a pledget of lint, soaked in a solution of perchloride of iron, should be pressed against the stump of the pedicle. If hæmorrhage occur, the cut surface may be touched by the actual cautery passed up through a speculum. 3. The pedicle of the polyp, having been brought into view as just described, may be divided by the *écraseur*, the same precautions as to hæmorrhage being taken. 4. The pedicle may be *ligatured.* This may either be done by bringing down the tumour as directed above, transfixing its neck with a large nævus-needle carrying a double whipcord ligature, and tying it in two halves. In order to prevent the annoyance resulting from the decomposition of the ligatured mass, the pedicle may be cut across immediately under the part to which the ligature has been applied. In some cases the ligature is gradually tightened. This operation is done by means of a whipcord applied by Gooch's double cannula, which has been variously modified and a good deal improved by different Surgeons. The ligature usually cuts its way through in from three to five days; the tumour swells, and decomposes, often with a good deal of fœtid discharge, which requires to be carefully syringed away by means of dilute chlorinated lotions. It is a useful precaution not to apply the ligature too near the uterine end of the pedicle; as cases have occurred in which, by so doing, the Surgeon has given rise to serious and even fatal inflammation of the womb. Any portion of pedicle that is left after the ligature has separated will gradually undergo absorption. Of these various methods, I think that, in the treatment of large polypi, removal by the écraseur, or the transfixion and ligature of the neck of the tumour and the immediate excision of the part below the ligature, is the safest, most expeditious, and the best.

**Cauliflower Excrescence** from the uterus, attended by copious discharge, is a rare and dangerous affection. The only *Treatment* that appears to be of any avail, is to draw down the neck of the uterus by means of a vulsellum, and then to excise the tumour with the surface on which it grows. This operation is not attended by any very serious hæmorrhage, and succeeds in ridding the patient effectually of her disease.

**Malignant Affections of the Uterus** usually commence in the form of scirrhous tubercle or ulceration of the cervix, attended by the ordinary local and constitutional symptoms of this affection; there is much offensive discharge, and cancerous cachexy speedily sets in.

The *Treatment* of these cases must be of a purely palliative character; the administration of opiates and the use of chlorinated lotions must be principally relied on. Excision of the diseased cervix has been recommended, and was formerly a good deal practised; but this is a barbarous procedure, and contrary to every principle of good surgery, as it is impossible to rid the patient of scirrhous disease by the partial removal of the affected organ, and its complete extirpation cannot be thought of. Tumours, however, of a simple character requiring removal are occasionally met with, springing from the cervix; they may be excised by putting the patient in the position for lithotomy, drawing the uterus well down with forceps, and removing them with the knife. This has been done during pregnancy, and even during parturition, with good effects.

## OVARIAN TUMOURS AND DROPSY.

Ovarian tumours of a cystic character are commonly met with. The cysts may be uni- or multi-locular, and vary greatly in the nature of their contents. These may be either solid or fluid—often a combination of the two. If fluid, the liquid is usually more or less viscid, albuminous, dark and variously coloured. Ovarian tumour, if left without treatment, invariably ends fatally; in some cases rapidly, in most gradually, occupying many years in its course.

Diagnosis.—It is not my intention to enter into the difficult subject of the diagnosis of ovarian tumours, which would lead me too far into the province of the Physician. From pregnancy, ascites, tumours of the uterus and omentum, dropsical dilatation of the Fallopian tube, hydronephrosis, enlargements of the liver, kidney, spleen, and stomach, hydatids, hysterical tympanites, fat in the omentum, stercoraceous accumulations, distension of the bladder, spinal curvature, abdominal and pelvic abscesses, the diagnosis has carefully to be made; and that this is a matter of no slight difficulty, is evident from the numerous cases in which errors have happened and are constantly occurring to the most experienced practitioners. It is impossible for the Surgeon to be too cautious in effecting a diagnosis before he proceeds to open the abdominal cavity in any supposed case of ovarian disease. And notwithstanding the great attention that has been expended on this subject, and the vast improvements in diagnosis that have been effected of late years, such errors are still of constant occurrence—even to the most experienced and skilful in the treatment of ovarian disease.

Treatment.—The treatment of ovarian tumour may be conducted:—1, by Medical Means; 2, by Tapping; 3, by Tapping conjoined with Auxiliary Measures; 4, by Injection; 5, by Ovariotomy.

1. **Medical Means** exercise no influence in curing ovarian tumours, and but little, if any, in retarding their progress. Specific treatment by means of mercury or iodine has always appeared to me to hasten the progress of the malady, by breaking down the constitutional powers of the patient ; and attempts at promoting the absorption of the fluid by purgatives, diuretics, &c. are invariably unsuccessful. An ovarian cyst is a parasitic growth, the tissues and structure of which are not influenced to increased power of absorption by the action of deobstruents on the system generally. The utmost that can be done by medical means in such cases is, to attend to the general health and to support the patient's strength by tonics.

2. **Tapping** in ovarian dropsy may be done as for ascites, through the linea alba ; but not unfrequently the tumour presents more distinctly at some other part of the abdominal wall, and may be emptied through the linea semilunaris ; or, if multilocular, it may require the trochar to be inserted at different points into its separate compartments. The paracentesis of ovarian cysts should, unless the disease be very acute, always be deferred as long as is compatible with the comfort of the patient ; as it is not only followed by speedy re-accumulation of the fluid, and often by rapid exhaustion, few patients surviving the first operation more than three or four years ; but is attended by certain special dangers, such as the risk of peritonitis, of exhaustion, or possibly even of the puncture of the bladder, or of a coil of small intestine, which is sometimes adherent to the anterior wall of the ovarian cyst, and may be met with where little expected. But independently of any positive danger of this kind, tapping an ovarian tumour is, as will immediately be stated, an operation that not only holds out no prospect of cure, but that is indeed usually the precursor of a more speedily fatal termination to the case than would otherwise occur. As a means of temporary relief it is clearly only applicable to unilocular cysts or to those multilocular tumours in which one cyst takes greatly the lead in point of size over the others. Indeed, so disastrous are the results of tapping that, since the development of ovariotomy and the increasing success of that operation, it is not often had recourse to, being only practised in certain exceptional cases that either do not admit of complete extirpation of the tumour, or in which it is necessary for various reasons to defer that operation.

3. **Tapping, conjoined with Auxiliary Means**, has occasionally succeeded in effecting a cure of unilocular ovarian cysts. These auxiliary means are of various kinds ; firm pressure ; incision of the cyst ; excision of a portion of its wall, plugging the aperture in it with a tent ; the introduction of a catheter or tube ; the establishment of a fistulous opening leading into the interior of the cyst, either through the anterior abdominal wall or through the vagina, have all been adopted in addition to simple tapping. However much these different procedures may vary in detail, they are all conducted on one principle ; viz., that of causing the gradual contraction of the cyst and the cohesion of its walls—a principle of treatment which is only applicable to unilocular cysts, and hence can only be had recourse to in a small number of cases, and those the simplest, of ovarian tumour. None of these means can be looked upon as curative, so far as ovarian disease is concerned. By means of them the cyst that is chiefly enlarged may be made to collapse and contract.

But secondary cysts developed in its wall, or at its base, and whose development has been kept in abeyance by the pressure and absorption of nutrition by the larger cyst, will commonly begin to grow when this has been reduced in bulk; and thus eventually a multilocular tumour may be substituted for an apparently unilocular cyst.

These measures have also, like tapping, given way to the safer and more certain procedure of ovariotomy, and are now confined to those cases in which from adhesions on the tumour it cannot be removed in its entirety.

4. **Injection of Tincture of Iodine** has been occasionally employed both in this country and the Continent. After the tumour has been tapped, from four to six ounces of the tincture are injected through a catheter, passed down the cannula, and left in. The immediate effect of this injection is the contraction of the cyst; the secondary effect, the effusion of plastic matter within it. In some cases no constitutional disturbance follows; in others, a severe febrile paroxysm, accompanied by intense iodism, the urine and saliva being impregnated with iodine; and in others again, suppuration of the cyst, with fatal peritonitis, has resulted. This method of treatment is only applicable, however, to non-adherent unilocular cysts: and in them it must be looked upon as palliative rather than curative—the cyst collapsing, and the tumour perhaps recurring in another form. It is, however, so very uncertain in its results—so entirely palliative and so manifestly inferior as a method of cure of ovariotomy, that it is now, I believe, generally abandoned.

5. **Ovariotomy** is probably the greatest triumph of modern Surgery in its operative department. In its original conception, as in its ultimate perfection, it reflects the greatest lustre on the British School of Surgery.

Its history is curious. Its progress was slow, and was marked by those oscillations in the judgment and the favour of the Profession which frequently precede the final establishment of a great advance in practice. The operation was originally proposed, and its practicability discussed in 1762, by William Hunter. It was strongly advocated and its practicability taught by John Bell, at a later period. It is said to have been performed in France, by L'Aumonier, in 1782, in a case of "scirrhous disease with abscess" of the ovary; the patient recovering. A pupil of John Bell—McDowell of Kentucky—first performed the operation in America in 1809; he followed up his case by others, and in all operated thirteen times. In 1823, Lizars operated for the first time in this country. But the operation, though several times repeated, fell into discredit, in a great measure owing to the imperfection of the diagnosis of the cases in which it was done, and was not revived until 1836, when Jeaffreson of Framlingham practised it successfully through a small incision an inch and a half long only. From this operation we must date the revival of ovariotomy in Great Britain. This operation was followed by others performed by King of Saxmundham, Crisp of Harleston, and West of Tonbridge. The example of these provincial Surgeons was followed by their brethren in London, and the operation was practised by many, especially by Walne, F. Bird, and Baker Brown, but with very discouraging results; for of 162 cases collected by Robert Lee, in 60 the disease could not be removed, and of these 19 died; whilst of the remaining 102, 42 terminated fatally. Not only did these unfavourable results discourage the Profession, but a growing belief sprung up that this mortality, great as it was, did not by any means represent the whole extent of the fatal cases, and notwithstanding that C. Clay of Manchester continued to operate, ovariotomy was in great danger of falling into such disrepute as to be excluded from ordinary Surgical practice. In 1857 appears for the first time in connexion with ovariotomy the name of a Surgeon, who was not only destined to revive ovariotomy, but to re-establish it firmly and definitively amongst the great operations in surgery; for in December of that year Spencer Wells performed his first operation of this kind. This case, the first of a series of 500 cases that have been published up to the year 1872, led to a revival of the operation. In Spencer Wells's hands ovariotomy assumed a new shape; its performance was guided by certain definite rules, and the results were of the most brilliant and successful kind. Not only has the success of these operations been unprecedentedly great, but it has been steadily increasing; of the first series of 100 cases, 34 died and 66 recovered; of the second series, 28 died and 72 recovered; of the third 100 cases, 23 died and 77 recovered; of the fourth, 22 died and 78 recovered; and in the fifth, 20 died and 80 recovered. Up to the end of 1876, the total number of cases operated on by Spencer Wells had amounted to the large number of 820, with 618 recoveries and 202 deaths. The last series of 320 cases showing 245 recoveries against 75 deaths; the last 20 cases being all successful. These results, admirable as they are, will probably still be improved upon, and Wells is of opinion that the mortality may be still further reduced so as to bring it down to 10 per cent. This low death-rate has been nearly attained by Keith of Edinburgh; who, in his series of 50 cases recorded in June, 1875, had only 6 deaths. In addition to this, the diagnosis of ovarian diseases and of other abdominal tumours has been greatly perfected, so that the number of cases in which the operation is attempted but cannot be completed, has greatly lessened.

In the face of such results as these it is no longer necessary to enter into any formal arguments as to the propriety of performing ovariotomy. Without doing so at any length it may, however, be stated that the operation has been chiefly condemned and cavilled at on two grounds; 1st, that, as the disease for which it has been proposed is not necessarily fatal, or, at all events, not incompatible with long life, it is not proper to subject the patient to a hazardous procedure for its removal; and, 2nd, that the mortality from the operation is so high as not to justify a Surgeon in performing it.

With regard to the first objection, it may be stated that ovarian disease is attended by very great discomfort and inconvenience in all cases; that it prevents a woman from discharging the active duties of life, and, amongst the poorer classes, from obtaining a livelihood; and that, so far from being a comparatively innocuous affection, it wastes and enfeebles the patient, interfering seriously with nutrition, and with the actions of the abdominal or pelvic organs, and is not generally compatible with prolonged existence. R. Lee states that about 80 per cent. of the cases that are not operated upon, die within one year and three quarters after the appearance of the disease. When it grows rapidly, or so soon as it attains such a size as to require tapping, death takes place much more quickly. Safford Lee states that of 46 patients with ovarian disease, who were tapped, 37 died, and only 9 recovered; and that of the 37 who died, more than one-half did so in four months from the first tapping, and 27 out of the 37 within a twelvemonth, and of these 18 were tapped once only. In those who survive, repeated tappings are required at constantly decreasing intervals.

The second objection can have little weight with any practical Surgeon. The mortality after ovariotomy is not so high as that after many operations which no Surgeon would hesitate for a moment in performing. It is true that in some of these cases, as in the ligature of the larger arteries for aneurism speedy death would be the penalty of non-interference; whereas, in ovarian disease, a miserable existence may be protracted for some months after the tumour has attained so great a bulk as to render surgical aid necessary. But in other surgical diseases in which operations of the gravest character are performed without hesitation, as in the removal of the upper jaw for tumour, or in amputation at the hip-joint for tumours of the femur, the same objection would hold good. The diseases for which these great and dangerous operations are performed, are not incompatible with some months or even years of painful existence; yet the Surgeon does not hesitate to give the patient the chance of a doubtful recovery, in order to extricate him from the miseries of prolonged suffering. It is not necessary, in order to justify an operation even of a dangerous character, that the patient be in *immediate* peril of death. It is sufficient that the death from the disease which it is proposed to remove should ultimately be certain, though it may be delayed by months or years of previous suffering. From this point of view ovariotomy appears to me to be a perfectly proper and justifiable operation, and it presents the advantage of the cure, if the patient recover, being complete and permanent. In it there is no mean; the death is speedy, or the cure complete.

Clay of Birmingham, in the appendix to his translation of Kiwisch's *Chapters on Disease of the Ovaries*, has collected from various sources the particulars of 567 cases. Of these, the operation was completed by the removal of the entire ovarian tumour in 425, or about three-fourths; the mortality being 183, or about 43 per cent. In 24 cases, the tumour was only partially removed; of these 14 died. In 13 cases, extra-ovarian (mostly uterine) tumours were removed; the mortality here amounted to 10. Of 105 cases in which the operation was abandoned, there were adhesions in 82; and in 23 the disease was mostly extra-ovarian, while in a few no tumour was found. Amongst these 105 abandoned cases, 27 died. The results of ovariotomy in the hands of those who have most extensively practised it of late years—as Baker Brown, Tyler Smith, Spencer Wells, Keith, Atlee, and Kœberle—are, however, much more favourable: especially those of Spencer Wells and Keith.

The mortality after ovariotomy appears to be increased by the existence of adhesions. When these complicated the operation, in those cases in which the ovarian tumour was completely removed, 49 per cent. of the cases died; when they did not exist, only 32 per cent. were fatal. In Wells's first 500 cases, the proportions were about 33 and 20 per cent. respectively.

When we compare these returns, not only with the mortality which follows operations of immediate urgency—as primary amputation of the thigh for injury—but with that which attends great operations for diseases that might be palliated and in which existence might be protracted for some little time—

as amputation at the hip-joint for tumour, or the ligature of the innominate and subclavian arteries for aneurism, or even lithotomy for the extraction of vesical calculus of large size in the adult—we cannot consider the mortality after ovariotomy so great as to interfere with the performance of the operation, if other circumstances justify it.

It has further been objected to ovariotomy, that it has not unfrequently happened that, after the operation has been commenced, it has been found impossible to complete it, owing to the existence of adhesions between the tumour and the contents of the abdomen. This objection is certainly a grave one; but I believe that, with care in examining the tumour, and ascertaining its mobility during respiration, the existence or absence of crackling under the abdominal wall during the respiratory movements, the freedom from connection with the uterus, as determined by finding that organ floating on the introduction of the uterine sound, and the previous non-occurrence of peritonitis, this mistake is not now so likely to happen as formerly, when the liability to it was not suspected.

**Operation.**—On the day preceding the operation, a dose of castor-oil should be administered, and on the morning of it an enema, so that the bowels may be completely emptied. The room should be airy, warm, and well ventilated. Chloroform having been administered, and the bladder emptied by the catheter, the patient must be placed upon a table covered with blankets, in such a way that the legs hang over the end of it, and the abdomen is fairly and evenly exposed. The Surgeon, taking his stand between the patient's legs, or at her left side, makes an incision, usually about four inches in length, from the umbilicus downwards, directly in the mesial line; by a few touches of the knife, the structures, which are usually much thinned, are divided along the linea alba, and the abdominal cavity is opened.

There has been much discussion as to the length to which the incision in the abdominal wall should be made; some practitioners recommending that this should be of very limited extent, others that it should reach from the ensiform cartilage to the pubes. No definite rule can be laid down upon this point. The incision must be proportioned in extent to the size and nature of the tumour, and the existence or absence of adhesions. If the tumour be cystic and unilocular, and not adherent, it may be readily enough extracted by making an incision only an inch or two in length in the mid-line, tapping it through this, and then drawing the emptied cysts forwards by means of a vulsellum. If, on the other hand, the ovarian growth be chiefly solid, a larger incision, from four to six inches in extent, will be required. Should adhesions exist, it may even be necessary to go beyond this; though I cannot believe that it is ever necessary to rip up the abdomen from the sternum to the pubes, for the removal of any tumour, however large or adherent. In making this incision, the Surgeon must be careful to open the peritoneum fairly, and not to mistake it for the cyst-wall, and so strip it off the inside of the abdominal muscles.

The tumour now comes into view; if cystic, it must be tapped with a large and long trochar, and the fluid evacuated. Especial care should be taken not to allow this viscid ovarian fluid to escape into and flood the abdominal and pelvic cavities. This may often be avoided by conducting it away from the patient, by means of a vulcanised India-rubber tube attached to the cannula. In this way, the size of the tumour may be so much lessened as to admit of its more ready extraction. If cystic, and emptied, it may now perhaps be drawn out through the incision in the abdominal wall without further difficulty. If it be solid, or if there be any adhesions, the Surgeon must introduce his hand, and, by sweeping it round the tumour assist in removing the mass. The chief difficulty in the operation will consist in the presence of adhesions. Should none exist, nothing can be simpler than the extraction of the tumour, which has a tendency to protrude forwards into the wound. Should they be slight and confined to its anterior part, attaching this to the abdominal wall, they may readily enough be broken through by the hand being swept round the forepart of the tumour. If they be firm, deep, and extensive, then the real difficulty of the operation will have to be encountered. It is, however, important to observe that adhesions of this kind will chiefly be found at the anterior part, between the tumour and the abdominal wall; comparatively seldom posteriorly, or connected with any of the abdominal viscera, except the uterus. If possible, these adhesions should not be cut across, as they often contain vessels that would bleed freely if so divided; but they should rather be torn—no slight force occasionally being required to detach them. Should the tumour be so closely adherent to any viscus that its separation is attended with danger, it might be safer to cut across the cyst-wall, and leave the adherent portion of this, than to run the risk of laceration of the liver or intestine. During the withdrawal or protrusion of the mass from the abdomen, an assistant on each side must press gently upon the sides of the incision with the hands or with soft napkins, so as to prevent the protrusion of the intestines, which, if possible, should not be seen during the operation. The tendency to intestinal protrusion sometimes occasions considerable trouble; especially if the patient have taken chloroform and begin to vomit, when it may be necessary to discontinue the operation for a time.

The **Management of the Pedicle**, including its seizure and division, is the next step in the operation, and probably the most important. It is the one on which the greatest amount of difference of practice exists.

There are three methods of securing the pedicle adopted by different ovariotomists and Surgeons, viz., the *ligature*, the *clamp*, and the *clamp* conjoined with *cauterisation*. The proper treatment of the pedicle involves two points: first, and necessarily, the arrest of hæmorrhage from its divided vessels; and secondly, the question as to whether its stump should be left out of the wound or allowed to drop into the peritoneal cavity.

The earlier operators used the *Ligature*; and many still employ it. This is certainly the simplest, and appears to me to be the safest, method of guarding against hæmorrhage from the cut stump. A strong, well-waxed whipcord ligature should be used. When the pedicle is long and narrow, there can be no difficulty in applying this; when short, thick, or broad, the ligature is not so easily applied. The tumour must then be drawn forwards, and the structures of the pedicle either expanded out or unravelled, as it were, when a double ligature can be passed across it, the loop snipped, and the pedicle tied in two portions; or the whipcord may be passed by means of a nævus-needle, which is made to transfix the pedicle at some point which the Surgeon has previously ascertained to be free from blood-vessels, and then securely knotted on each side. Great care must be taken in tying the pedicle very tightly, for undoubtedly one of the great disadvantages of the ligature is that, owing to the shrivelling of the pedicle, it is apt to slip, and thus to lead to a fatal hæmorrhage.

There are two methods of dealing with the ends of the ligatures. The first is, to leave them and the stump of the pedicle out of the wound, securing them to the edges of the abdominal incision, or to the harelip pins by which it has been brought together. This method I formerly used and advocated ; but more recent experience leads me to concur with those who consider it as favouring suppuration, sloughing, and purulent deposits in the lower part of the wound and the pelvic cavity.

With respect to the question of keeping the stump out of or allowing it to drop into the peritoneum, opinion is divided.

Some of the earlier American ovariotomists, especially D. L. Rogers, cut the ligatures short and returned the stump of the pedicle into the wound. This practice was revived by Tyler Smith in 1861, and has been adopted by him, by T. Bryant and others, with excellent results, the ligatures either becoming encapsuled or being discharged after a time through a suppurating track. But when the clamp is used the case is different. Here the opinion of Spencer Wells, backed as it is by his extensive experience, is as positive as it is valuable. He strongly advocates the practice of securing the pedicle with the clamp outside the wound, so that it should not drop down between the lips of the incision in the skin and abdominal wall. The mortality of cases so treated was 19.7 per cent. He strongly deprecates all minor and mixed methods of keeping the pedicle out of the incision, as being far inferior to the clamp in effecting this object. The mortality after the *intra*-peritoneal treatment of the stump was 38·6, or as nearly as possible double that of the *extra*-peritoneal plan of treatment ; and these figures appear to be conclusive as to the relative merits of the two.

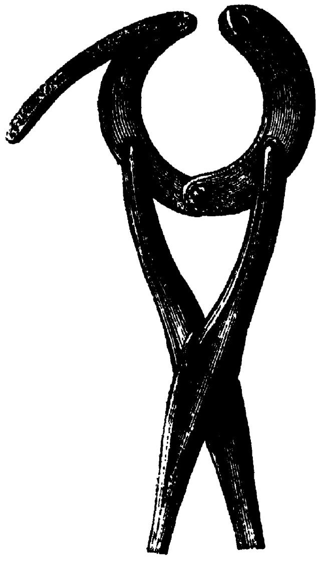

Fig. 860.—Spencer Wells's Elliptic Clamp.

I forbear to speak of the employment of silver, lead, or other metallic ligatures, as they have fallen into disuse, and been abandoned by the most experienced ovariotomists ; as also have the methods of bringing the ends of the threads out through the "fovea inguinalis interna" or the vaginal septum, which are manifestly not worthy of adoption.

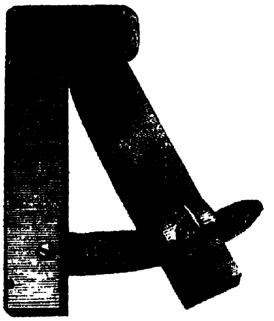

Fig. 861.—Triangular Clamp.

The ligature possessing the obvious disadvantages of favouring suppuration, and of not being a positively effectual security against hæmorrhage, the **Clamp** was introduced as a substitute by J. Hutchinson in 1858, and, after having undergone various modifications, is now, in some shape or other, employed by very many ovariotomists. The object of the clamp is to compress the pedicle securely until loosened by suppuration. The clamp originally employed was a pair of carpenter's callipers: those now used by Spencer Wells are here figured (Figs. 860, 861). They are so constructed that, after their application, the handles can be removed, and the compressor alone left on the pedicle. The action of this instrument is obvious. The pedicle, being seized, is firmly compressed, and then cut through about half an inch above the clamp. This, being concave on the upper surface, allows the stump to be dressed easily, and acts as a saucer to collect any discharge. The ligature of independent-vessels may also be combined with compression of the whole pedicle by the clamp.

**Cauterisation** with compression was introduced by Baker Brown as a means of securing the pedicle and arresting hæmorrhage. It is a method that has not been very generally adopted, owing to the liability to recurrent hæmorrhage that accompanies it. According to Lloyd Roberts, of Manchester, in an excellent paper on the treatment of the pedicle, this happens in one out of four cases. It is apt to occur when only the cut surface of the pedicle is cauterised; the eschar being then too weak to restrain the pressure in the arteries. It is best guarded against by searing and coagulating at least an inch of the pedicle. Should it be thought desirable to use cauterisation, the best instrument would be Chambers's actual cautery parallel clamp (Fig. 862).

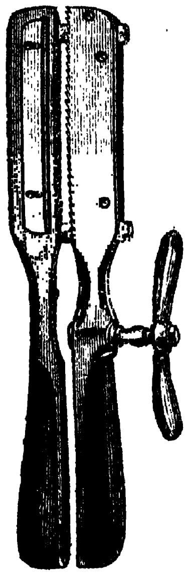

Fig. 862. Chambers's Actual Cautery Clamp.

The incision in the abdominal wall should be closed by the continuous suture passed from within outwards. For this purpose a silver wire or carbolised silk suture may be used, and care should be taken that the opposite sides of the peritoneum are brought well into contact and fastened together.

The abdominal wall must be still further supported by broad and long slips of plaster, and a laced napkin round the body.

Should it unfortunately be found, during the progress of the operation, that adhesions exist, so close and extensive as to prevent the removal of the tumour, the wound in the abdominal wall must be closed, and the same after-treatment adopted as in the successfully completed operation.

The **After-treatment** of the case will require the most careful attention, although it presents nothing of a very special character, or that differs from the management of ordinary abdominal operations. The dangers to be apprehended are from peritonitis, exhaustion, and secondary hæmorrhage. Peritonitis requires to be more carefully guarded against than perhaps any other complication: of 150 fatal cases, it was the cause of death in 64, or 42 per cent. Pure air, perfect cleanliness, complete quiet, and the undivided attention of a skilled nurse, are, according to Spencer Wells, the main requisites. The patient should be kept in bed, in a uniform temperature. Nothing but ice and barley- or Seltzer-water, brandy, and beef-tea should be allowed for several days; and opium given, if necessary. The urine must be drawn off thrice in the twenty-four hours ; but the bowels should be left unrelieved for several days, and then merely opened by an enema. As no solid food should be taken during this time, little inconvenience results. If peritonitis come on, it must be treated in accordance with the rules laid down when speaking of that which follows strangulated hernia. Should symptoms of exhaustion manifest themselves, the patient must be kept up by wine or brandy, repeated as frequently as the irritable state of the stomach will permit.

After recovery from ovariotomy, the cure is usually complete. Impregnation may occur through the medium of the ovary that is left ; and parturition may be safely accomplished. In some rare instances, however, the ultimate result is not so fortunate. If the tumour have been malignant, recurrence may take place ; and occasionally the ovary that is left becomes the seat of disease, so as to necessitate a second operation.

HERNIA OF THE OVARY. It may happen that the ovary, on one or both sides, becomes displaced, and escapes from the pelvis through one of the openings which give passage to intestinal hernia. In three-fourths of the recorded cases (twenty-seven out of thirty-eight, according to Englisch of Vienna) the displacement has been inguinal. In nearly one half of the cases it was congenital ; all these were instances of inguinal displacement ; and all the instances of double ovarian hernia were inguinal and congenital.

The *Causes* of the displacement in the adult are not easily ascertained. In the congenital cases it would seem as if an abnormal descent of the ovary took place, analogous to the descent of the testis in the male.

*Symptoms.* Congenital ovarian hernia is nearly always irreducible ; while in most cases of acquired displacement of the ovary, it has been possible to return the tumour into the abdomen. The swelling is generally pyriform in the inguinal region, rounder in the femoral. There is no constant diagnostic symptoms ; but in several instances it has been noticed that the hernia became more tender on pressure, and larger, during menstruation. At this time, also, inflammation of the ovary may take place ; and, being attended with vomiting, may lead the Surgeon to imagine that the case is one of strangulated hernia. The diagnosis here is not easy ; indeed, according to Englisch, of twenty cases, in which symptoms of strangulated hernia were present, a correct diagnosis was made in seven only. The difficulty of diagnosis would be much increased if an intestinal or omental hernia were present with the ovarian. Abscess or sloughing of the displaced ovary occasionally occurs.

*Treatment.* So long as the hernia presents no special symptoms there is little or no occasion for interference, beyond the wearing of a properly fitted truss. If inflammation occur, the case must be treated on ordinary principles ; and if the ovary suppurate, the abscess should be opened. When the ovary is very painful, or has become cystic, extirpation may be practised.

# ADDENDUM TO VOLUME II.

## PAGE 300.

### TREATMENT OF DISEASED SPINE BY PLASTER OF PARIS BANDAGE.

Dr. Lewis A. Sayre, of the Bellevue Hospital, New York, has very ingeniously applied the plaster of Paris bandage to the treatment of caries of the spine with angular curvature, and to some of the more severe forms of lateral curvature. The following is a brief summary of the details of this method of treatment.

The shirt being removed, a thin, closely woven vest without armlets is put on next the skin; and a large pad is placed over the abdomen under the vest. The child then standing under a tripod stand, to the apex of which is attached a block-and-fall arrangement carrying a horizontal iron bar, a padded collar is buckled round the head and chin, while padded stirrups are passed under the arms; straps are then passed separately from the collar and arm-stirrups to the iron bar above. By adjusting these straps, the relative tension upon the head and arms can be adjusted with nicety. The indication that the proper amount of extension has been made with the pulleys, is the comfort experienced by the patient. When thus suspended, the spine becomes much straighter; the ears are lifted from the shoulders, and the diseased surfaces of the vertebræ are thus prevented from pressing upon one another. The patient is now directed to take a few deep inspirations. Plaster of Paris bandages are carefully applied round the body from the pelvis to the arms; and strips of thin perforated tin are placed by the sides of the spine, and a second layer of plaster bandages passed round the whole. The straps being now removed, the child is laid upon a mattress. As soon as the case is dry, the abdominal pad is withdrawn; and the patient, when erect, is found to be one to one-and-a-half inch taller. In cases of caries of the cervical region, a head-piece is adjusted to the body-case, by means of which the spine may be relieved of the weight of the head. After two or three months, the case may be slit down the front and fastened with eyelets. After such treatment, it is commonly seen that respiration becomes easy and the circulation free, while symptoms due to irritation of nerves subside. Dr. Sayre strongly insists on the importance of practical details, such as the use of loose-textured bandages and suitable plaster, a closely fitting elastic shirt, and, above all, securing a perfect adaptation of the case. Further details as to Dr. Sayre's practice will be found in his *Orthopædic Surgery*, 1876; *the Richmond and Louisville Medical Journal*, May, 1877; and the *American Practitioner*.

The essential points in this treatment, are 1st: Extension of the spine by suspension, and 2nd: Fixing the spine when so extended in a firm and light casing.

# ERRATA.

Page 188, line 14, *for* "incision" *read* "excision."
,, 601, headline, *for* "Throat" *read* "Breast."
,, 733, line 6 from bottom, *for* "cellutitis" *read* "cellulitis.
,, ,, line 17, *for* "off" *read* "of."
,, ,, line 18, *for* "Kinfe" *read* "Knife."
,, 775, line 13 from bottom, *for* "on" *read* "one."
,, 873, line 26, *omit* comma after "to."

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